STUDY OF THE ORDERS

AMERICAN SCHOOL *of* CORRESPONDENCE
CHICAGO ILLINOIS
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PART I

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STUDY OF THE ORDERS

PART I

INSTRUCTION PAPER

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STUDY OF THE ORDERS.

THE ROMAN ORDERS.

Introduction. This textbook on the Roman Orders is largely an adaptation and simplification of a work published in 1870, entitled "An Analysis of the Five Orders" by F. Laureys, architect, and professor at the Royal Academy and Industrial School of Brussels. Professor Laureys has taken the standard orders as shown in the plates from the better known work by Vignola, and has further elaborated their system of construction. He has explained in detail many parts of the plates and orders of Vignola, which that authority has left vague or indeterminate, and has generally succeeded in attaining a more distinctive type-form in the instances where he has chosen to deviate from the original. The three order plates from Vignola may be considered as "key-plates" showing the proper relation of the more detailed drawings adapted from the elaborate system of Professor Laureys, and the proper assemblage of the different parts of the order in such a manner as to give a comprehensive idea of the whole.

The included plates from Palladio furnish alternative versions of each of the three orders and are valuable as showing in many instances the authority for the changes which Professor Laureys has chosen to make from Vignola. Vignola and Palladio were practically contemporaneous Italian architects living in the sixteenth century, the first—possibly better described as a thinker and analytic theorist—residing in Rome; while Palladio worked in the north of Italy and, either through better opportunity or a differing temperament, has amply proved by his practices the value of his works.

It must be understood that these so-called Roman orders are not the orders used by the Classic Roman builders in any instance, but are versions made in this sixteenth century from the then-existing buildings and remains of Roman work, and each of these orders was intended to become a "type-form," or composite of the best features of the varying ancient examples. They are, therefore, more distinctively products of the Renaissance and might more appropriately be termed the Renaissance Classic orders, but in contradistinction to the still earlier and radically different creations of artistic Greek workmen, these examples are known as the Roman orders. Indeed, however much they may differ in detail from the Roman originals, they are carried out in as close an approximation to the spirit of Roman work as would be possible at any later date, but differ radically from the spirit and intent of the preceding Greek work, upon which the Romans had in turn founded and developed their application and use of the orders.

Some buildings are the logical outcome of the needs they are designed to serve, or of the nature of the materials used in them; others have been evolved by the artistic genius of different peoples, and have gradually been perfected in the advance and progress of civilization and art. Such buildings possess an æsthetic or artistic character, and are the natural expression of particular peoples at a given stage of their civilization.

The Greeks and the Romans, the most cultivated nations of ancient times, brought their architectural forms to a very high degree of perfection. The destruction of ancient civilization by the Fall of the Roman Empire in the 5th century A. D. and the spread of Christianity, caused the complete disappearance of Greek and Roman architecture during several centuries. This period is called the Middle Ages and lasted until the 15th century, but during this time a new civilization was developing and producing an architecture, which in certain countries (notably in France) attained a very high degree of perfection.

In the 15th century, however, the study of ancient literature brought about an intellectual reaction which led both science and art into sympathy with Greco-Roman antiquity. Architecture then discarded the artistic forms of the Middle Ages and adopted new forms derived from the remains of ancient Rome. This period was called the Renaissance, and from it we may date the academic study of architecture, based on the architecture of Greece and of Rome. To the architectural style at this time adopted as a standard for study in the classroom, has been given the designation "Classical," and as the principles of classical architecture are the easiest to formulate and retain, it is most helpful to begin with the study of these. An accurate knowledge of classical architecture is essential to the study of all other styles.

1. Architecture is the art of designing and constructing buildings.

2. The designing of buildings consists in a graphic (or plastic) representation of their intended shapes and sizes.

3. An architect uses mechanical drawing to express his ideas and to record exactly the size and shape of the object represented.

4. In mechanical drawing, the instruments used to draw the straight lines and the curves which express the forms of objects, are, among others, the straight edge, triangle and compass.

5. In general, full straight lines indicate visible edges, and broken or dotted lines indicate relations of different parts, such as the axis or center-line of a street or building or the distance covered by a figured measurement.

6. Horizontal lines are drawn along a T-square whose head rests against the left side of a drawing board. Vertical and sloping lines are drawn against a triangle resting against the T-square. (Fig. 1).

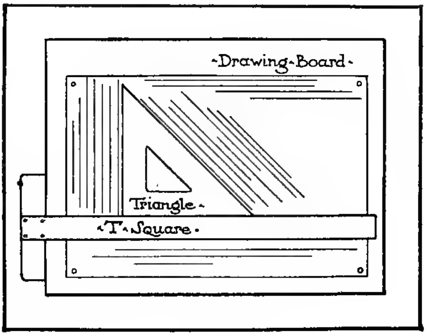

Fig. 1.

7. Two horizontal lines intersecting two vertical lines, all of equal length, form a square. If its opposite corners are connected by straight lines, called diagonals, the intersection of these diagonals gives the center of the square. A horizontal and a vertical line may be drawn through this center, and then, by setting the point of the compass at the center and opening the compass along either of these lines to the sides of the square, a circle may be drawn which will be exactly inscribed within the square. The square itself will be divided into four small squares, each of which contains a quadrant or quarter circle. (C, plan, Fig. 2.)

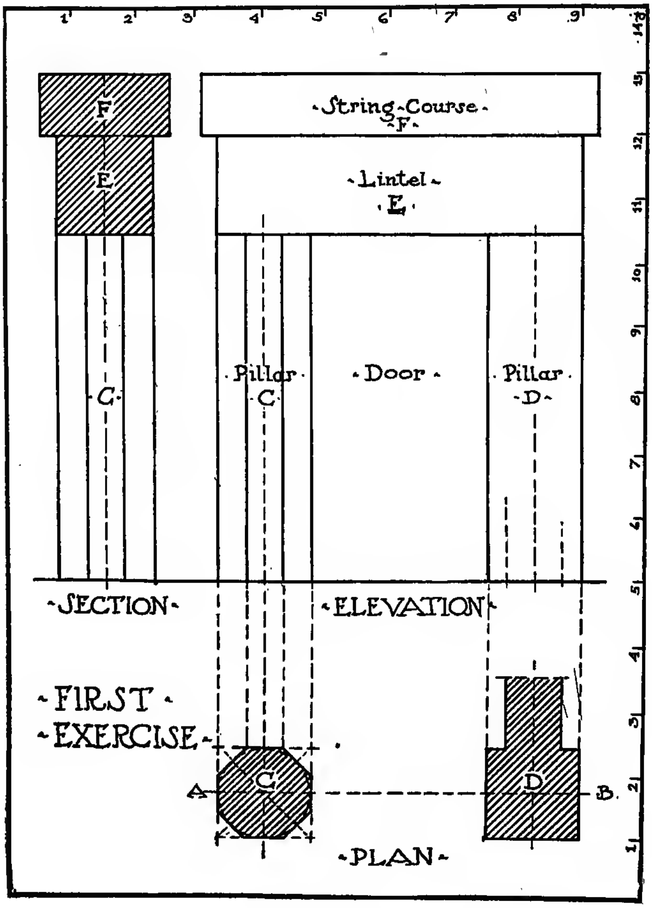

Fig. 2.

8. The circle is divided into 360 parts, which are used for measuring angles or the difference in direction between any two lines that meet in the center of the circle. For convenience, an instrument called a protractor is sometimes used, which consists of a half-circle divided into 180 parts called degrees (°). A vertical line from the center of the circle will cut the curve or circumfer-

ence at a point 90° above the horizontal, and the diagonals of the square in which the circle is inscribed will divide each angle of 90° into two angles of 45° each.

9. As it is impracticable to draw many objects at their full size, an arbitrary scale is used to enable the drawing to be made at $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{16}$, $\frac{1}{32}$, or some other fraction of its true size. Drawings at the scale of $\frac{1}{4}$ inch to the foot reproduce each dimension of an object at $\frac{1}{48}$ of its true size. The system of drawing things "to scale" enables us to make accurate drawings at any convenient size.

10. To make pictures of objects in such a way as to express accurately the size and shape of every part, three drawings are usually necessary—a plan, a section, and an elevation—the plan to show widths and lengths, the section to show widths and heights, the elevation to show lengths and heights.

11. A drawing looks better when its perpendicular center is half-way across the paper and its bulk placed slightly above the horizontal center of the sheet. Begin then by finding a point in the paper half-way between the sides, and through this center draw a vertical line — the vertical axis of the drawing. Lay out the plan, the elevation, or the sum of the two together with the space between them, so that half the finished work shall be on each side of the vertical axis.

12. In mechanical drawing, it is best to begin by indicating the axes or center lines of objects in plan, section and elevation. On either side of these axes lay out one-half of the width or depth of the objects represented.

13. A pier or pillar is a mass of stone, wood or metal standing on end and used as a support. (Fig. 2, C.)

14. A lintel is a piece of stone, timber, or metal laid flat upon two pillars so as to form an opening or bay. (Fig. 2, E.)

15. A string course is a horizontal band of stone, brick, or other building material projecting beyond the face of a wall. (Fig. 2, F.)

16. The first exercise, Fig. 2, shows two pillars C and D, carrying a lintel E, above which is a string course F. The plan shows the width and the depth of the pillars C and D. It shows that pillar D is square and that pillar C is eight sided (octagonal.)

It also shows that these two pillars are set along a straight line or axis (A-B) having the same direction as two of their sides. The section shows the vertical position, the depth and the height of the pillars, the width and the height of the lintel E, which rests on the pillars so as to line with their face; and last of all the height and the width of the string course F, with its projection beyond the lintel E. The elevation shows the general arrangement of pillars and lintel as seen from an arbitrary viewpoint directly in front. It shows that the two pillars are upright or plumb, indicates the shape of the space between, and gives the length of the lintel and of the string course.

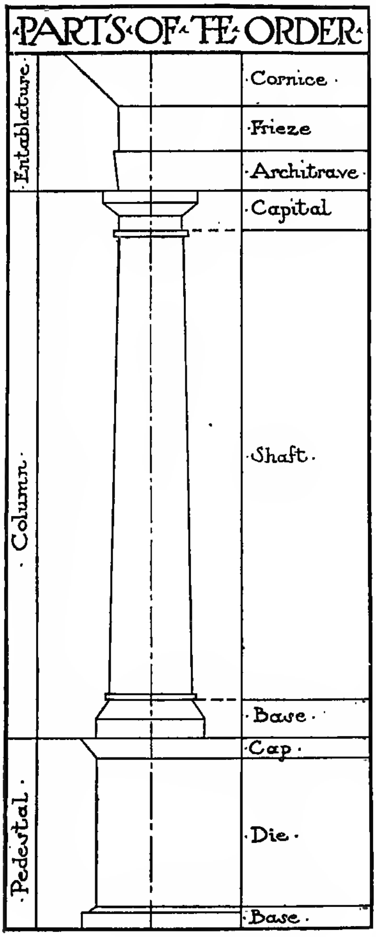

Fig. 3.

17. All the parts of this drawing have definite relations of size which are called proportions. Each pillar is one unit and a-half wide, one unit and a-half deep and five units and a-half high. The space between the pillars is two and three-quarter units wide and five and one-half high; its width is, therefore, one-half its height.

18. When a pillar is cylindrical or rounded, it is called a column and is divided into parts, the major part being termed the shaft. (Fig. 3). The shaft is the portion extending between the base and the capital, or between the capital and the support upon which the column rests. The shaft generally rests upon a projecting block or base included as part of the column, and is crowned with another projection called a capital.

19. Columns are connected to one another overhead by a timber or stone called the architrave. Generally there is above the architrave a plain space, called the frieze, lining with the neck of the column below, and above the frieze a projecting mass that completes the whole and is called the cornice. The architrave, frieze, and cornice taken together are called the entablature. A column with an entablature constitute an Order of Architecture.

20. Sometimes an Order of Architecture is set upon a mass of a certain height which is called the pedestal. The pedestal often has a base, and a cornice or crowning member called a cap. The space between the base and the cap is called the die of the pedestal.

21. There are sometimes used at the corners of buildings, or elsewhere against a wall, flat pillars having, like the column, a base and a capital. These pillars are called pilasters.

22. For the sake of elegance and lightness, the shafts of columns and pilasters are generally made smaller at the top than at the bottom. This prevents the shafts from appearing clumsy. They do not, however, taper all the way from the base upward, but only from a point one-third the height of the shaft above the base. Above this point the outline of a column or pilaster shaft is a gentle tapering curve. This swelling curve or taper is called the "entasis" of the column.

23. It must be noted that the diminution of the pilaster is much less than that of the column, and that in some cases the pilaster is of the same width at the neck as at the base. As specifically shown hereafter, there are certain relations between the necks and bases of columns and pilasters of each of the Orders. Occasionally, where a pilaster is used alone upon the corner of a building and not in immediate association with a tapered column, the pilaster shaft is, for obvious reasons, of the same width at the neck as at the base. See plates XXVII and XXVIII.

24. When square pillars carry vaults or arches instead of lintels, the pillars are called piers (Fig. 4). If a support is square or oblong in plan, and its thickness in relation to its height is considerably more than the thickness of a column, it is called a pier even though it carries a lintel. When a pier is topped by a projecting stone or series of mouldings from which an arch springs, this projection is called the impost, and the projecting band or border that is often placed around the edge of the arch is called an archivolt. Piers generally rest upon a base or plinth.

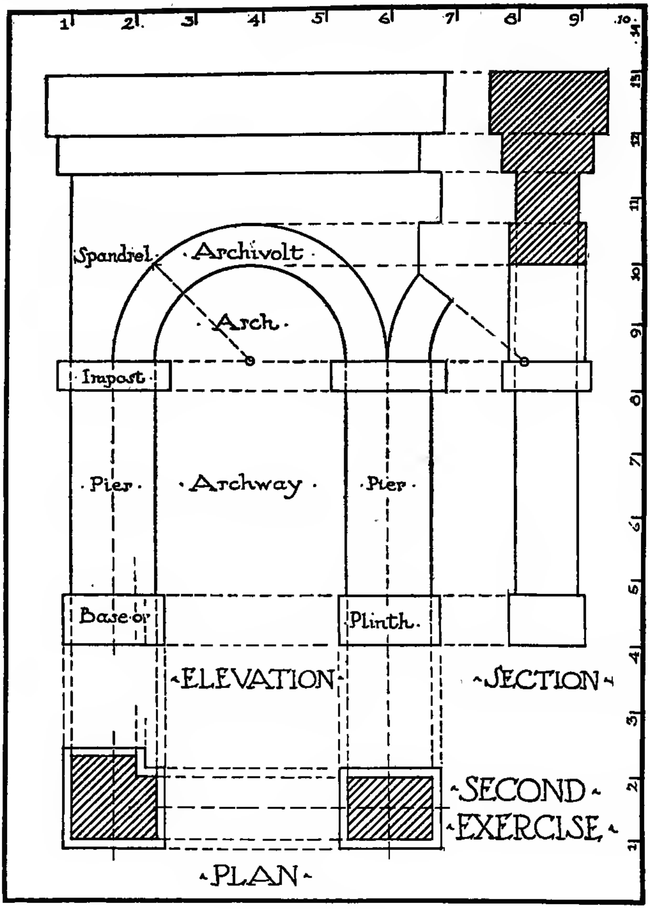

Fig. 4.

25. An arch is a support constructed of separate stones, units, or voussoirs, with its center higher than its two ends, and of an outline which is, in part or entirely, a circle, or a curve laid out from one or more centers. A vault is a continuous arch roofing over a room or passage, whose length is considerably greater than its width. A series of arches in succession opening upon the space covered by a vault, may be called an arcade.

26. Note the distinction between the lintel, a single horizontal member carrying a superimposed weight to the piers by its own strength, and the arch, a curved construction which carries a superincumbent weight by transferring its load to the piers or supports from which it springs, but unlike the lintel, adding a certain lateral "thrust" which the supports must resist.

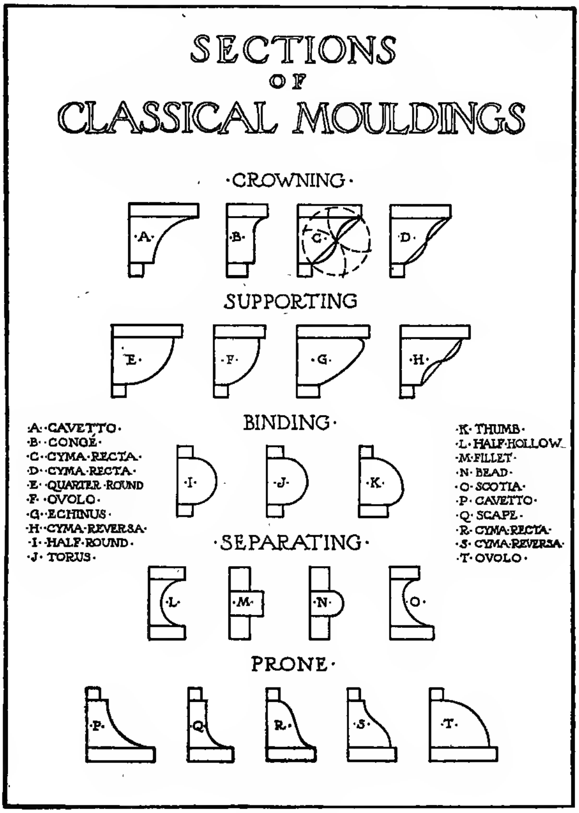

Fig. 5.

27. Bases, capitals, lintels, cornices, imposts, and archivolts are composed of separate members of straight or curved profiles, and these members are called mouldings.

28. Classical mouldings may be divided into five classes: crowning, supporting, binding, separating and prone. The mouldings most frequently used are the quarter round, Fig. 5 (E); the cove or cavetto, (A); the torus or half round, (J); the cyma, (C);

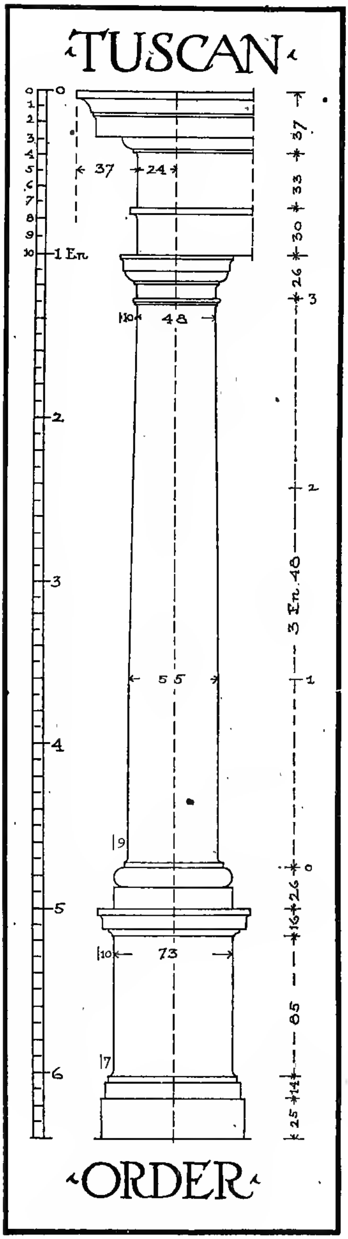

Fig. 6.

the ogee or cyma reversa, (H); and the scotia, (O). The quarter round, cove and torus are simple mouldings whose outline is an arc of a circle; the cyma, ogee and scotia are composite mouldings outlined by the arcs of two or more circles. The fillet (M), while never occupying an important position, is continually used to finish off or to separate the more important mouldings.

29. Classical architecture includes five Orders that differ in the proportions of their columns and in richness of their ornamentation. These Orders have long been called the Tuscan Order, (Fig. 6); Doric Order, Ionic Order, and Corinthian Order, (Plate I) and Composite Order, (Fig. 17). The Doric, Ionic and Corinthian orders are the most important, as they are now in more general use.

30. The five orders have one proportion in common, viz.: the relation of the height of the column to the height of the entablature. The entablature in all five orders is one quarter the column height. The height of the column in any order is therefore the height of four entablatures, and the height of the entablature, although a variable quantity, will always bear a certain relation to the general height of the order.

31. The height of the entablature divided into one hundred parts establishes a scale which may be used in determining the proper proportions of all parts of the order. This scale unit is called the Entablature or "En" and its one hundred parts are, where necessary to show more minute divisions, sub-divided into tenths which are expressed decimally.

32. Another system of measurements which is often used is based upon a unit called the "Module" which is always equal to the radius of the column shaft at the base. This unit, like the "En," may vary in different examples but will always have a definite relation to the order as a whole in any particular case. The "Module" is sometimes subdivided into twelve parts, sometimes into eighteen and sometimes into thirty, depending upon the order considered and the system of measurement to be adopted. It is, therefore, not so reliable a unit as the "En," and the latter will be used in this work. Some of the plates from Vignola and Palladio, however, are drawn according to the "Module" system. It is only necessary to remember that the "Module" is always equal to the semi-diameter at the base of the column.

33. The figured dimensions of a drawing are written along vertical lines in measuring heights, and along horizontal lines in measuring widths. A figured drawing is one whose dimensions are expressed in figures, and the extent covered by each measurement is denoted by dotted measuring lines and by spurs or arrow heads, two of which when meeting form a cross.

34. The most striking difference between the Orders is in the proportions of the columns, whose heights, as already noted, are equal to four entablatures, but whose diameters just above the bases are as follows:

Tuscan order,	55	parts	of the	Entablature	or "En."
Doric order,	50	"	"	"	"
Ionic order,	45	"	"	"	"
Corinthian order	40	"	"	"	"
Composite order	40	"	"	"	"

From the Tuscan to the Corinthian Order the thickness of the column decreases evenly by five parts at each step.

35. The shafts of columns, as we have already seen, are less thick at the capital than at the base. The upper diameter of the columns of the different orders is: for the—

Tuscan	Order,	48	parts.
Doric	"	44	"
Ionic	"	39	"
Corinthian	"	36	"
Composite	"	36	"

36. The Tuscan and Doric columns have one relation in common,—the height of their capitals, which is twenty-six. The cornice in both these orders has a height of thirty-seven.

37. The entablatures of the Ionic, Corinthian and Composite orders have certain general proportions in common, and all the general proportions of Corinthian and Composite columns are identical.

38. When orders are set upon pedestals, the latter must harmonize in their proportions and decoration with the orders carried by them. The height, however, is variable, being generally prescribed by the practical requirements of each building. A good average height is 1 En 40 parts or 140 parts. Although pedestals are not component parts of the orders it is convenient to call them according to their characteristics, Tuscan pedestals, Doric pedestals, Ionic pedestals, etc., as the case may be. The several orders differ in the complexity of their mouldings and the richness of their ornamentation.

TUSCAN ORDER.

39. Although it has been deemed best to restrict this textbook to a consideration of the three Roman orders termed the Doric, Ionic and Corinthian, the simpler Tuscan Order is shown sufficiently in detail to enable the student to use it in the exercises as required. The simplicity of its mouldings and the comparatively few lines required to express its component parts seem especially to fit this order for the earlier required drawings. The general proportions of the Tuscan Order are shown in Fig. 6, while the details may be more carefully studied in the full page drawing, Plate II

40. The shaft of the column has at its lower extremity a projecting member called the listel, surmounted by a curved member called the congé or cove, which is itself a continuation of the outline of the column shaft. The listel rests directly upon the base and is three parts in height and the same in projection, therefore the surmounting congé is in outline just a quarter of a circle.

41. The height of the base without the listel is 26 parts, divided between the plinth, which is 14 and the torus which is 12. Since a torus has the form of a semi-circle, its projection is one-half the height, that is to say six, which—with the projection of the listel—makes the total projection of the base beyond the lower part of the shaft nine parts.

42. The projection of the base determines the width of the die of the pedestal whose face corresponds to the face of the plinth above, and it is from this face that the projections of its cap and base are measured. These projections and moulding sections are shown at the left of the drawing in Plate II.

43. The shaft of the column is terminated below the capital by a moulding composed of a congé, a fillet, and a small torus which is called a bead; these mouldings taken together are termed the astragal.

44. The Tuscan capital is very simple, and is composed of three principal parts. Above the astragal occurs the necking, 8 parts in height and ending in a congé. Then comes a fillet 2 parts high. Above this is the quarter-round 6.5 parts in height and of equal projection. The upper part of the capital is composed of the abacus, ending in a congé and fillet, the whole 9.5 parts high. The abacus is, like the plinth of the base, square in plan. The total projection of the upper edge of the abacus from the face of the necking is 10 parts.

45. The architrave is composed of a single face, terminated by a cove and a listel. The total height of the architrave is thirty parts, of which twenty-five are given to the face and cove, and five to the listel. The projection of the listel is four parts.

46. The frieze of the Tuscan Order is thirty-three parts in height, and is terminated at the top by a congé.

47. The cornice is composed of three principal parts: the quarter-round, the corona and the cavetto. To each of these parts is also given a fillet or listel to finish or separate it from the adjacent mouldings. An alternative entablature is shown upon the same plate, lining with the one just described.

48. On this plate (II) are also shown the details of two imposts and an archivolt which may be employed in the decorated arcades of the Tuscan Order. The imposts are twenty-four parts in height, and the archivolt is thirty parts wide.

DORIC ORDER.

49. There are two styles of the Doric Order, the Denticular Order and the Mutular Order. The difference between these two styles is purely decorative and will be explained in the course of this analysis.

50. The Doric column, more elegant than that of the Tuscan Order, is sometimes fluted with segmental channels, the intersection of which form a sharp raised edge or "arris." These channels are always twenty in number, and are so placed that one is always seen in the center of the column on each of its four faces.

51. To draw a column with channels, it is necessary to make a plan just above the base, that is to say, at its greatest diameter, and another at its smallest diameter or at the necking of the column. (Plate III.) Having divided the semi-circumference into twenty different parts, and having determined the radius through each point of division, draw a chord of the arc comprising two of these divisions; and with an opening of the compass equal to one-half of this chord, and from the point where it intersects the radius which divides it into two parts, draw a semicircle outside of the circumference of the column. The summit of this semi-circle will be the center of the arc of the circle that forms the channel. By taking the corresponding point on each alternate radius all the channels may be drawn with the same opening of the compass. As a result of this method, the arc of the Doric channel is exactly a quarter circle.

52. The head or upper part of each channel is a semicircle, while the foot rests on a plane inclined at forty-five degrees. In drawing a channeled column there is but one channel seen in direct front elevation, the others follow the curvature of the shaft, and are drawn according to their positions on the plan. They form at the upper and lower extremities different curves which can be obtained only by projecting the proper points.

Thus, to obtain the curves formed by the heads of the channels draw (in elevation) the semi-circle forming the head of the central channel, and divide the plan of each one into eight equal parts. Now project upward the points of division on the plan of this central channel by vertical lines drawn to intersect the semi-circle in elevation. From these points of intersection, draw horizontals which will pass through all the other channels. Then draw verticals from the plan of each channel, as has already been done with the central one, and at the intersection of these verticals with the respective horizontal lines, points of projection may be marked by means of which one may describe the various curves.

For the foot of the channels the section must be used to establish the points of projection by dividing the inclined plane into three equal parts, and from each of these points of division, horizontals passing through all the channels may be drawn; then, dividing the depth of the channel on the plan into three equal parts, one may draw from the center of the column, two circles passing through all the channels. At the points where these circles intersect the outlines of the several channels, points are found in plan which may be projected to the horizontals of the elevation. Through these points may be drawn the several curves of the channel footings.

53. This plate shows also the details of the capitals and bases of the two Doric Orders. The left half shows the Denticular and the right half the Mutular Order. The capitals have the general characteristics of the Tuscan capital, but they have several differences of detail. For example, the abacus is enriched by a small cyma-reversa with a listel or fillet; while the necking is separated from the quarter-round by three "annulets" in the denticular, and by an astragal in the mutular order.

The height of the Doric capital is the same as that of the Tuscan Order, twenty-six, divided thus: the necking eight, the annulets or astragal three, the quarter-round five, the abacus six, the cyma-reversa two, and the listel two; the total projection of these members is ten, of which two is the projection of the cyma-reversa, .5 is the projection of the abacus beyond the quarter-round, five for the quarter-round in the denticular order, and 2.5 for the three annulets.

The quarter-round in the mutular order is of the same height as in the denticular but it has a projection of six, and is drawn with a radius of six, and the congé of the astragal has a projection of one and five-tenths. The shaft of the column terminates below the necking of the capital by an astragal of three parts, of which one is for the annulet, and two for the bead or ring; the congé has a projection of one.

Sometimes, in order to give increased richness to the capital, certain mouldings are carved. The cyma-reversa of the abacus is adorned with the leaf and tongue ornament, the quarter-round with eggs and darts, and the "baguette" or bead with beads and reels.

54. The Doric base is twenty-four parts in height, divided among the plinth of twelve, the torus of nine, and a bead or ring of three; the fillet below the congé of the column is two in height. The projection of the base is eight, comprising the congé of the column, which is two, the bead 1.5, and the torus 4.5.

55. The Doric entablatures are shown in Plates IV and **V.** The architraves have a characteristic ornament which consists of a row of small truncated cones (or pyramids) called "guttae," attached below the listel of the architrave to a small band called the reglet or taenia. Their position corresponds to the channeled parts of the frieze above, which are called the triglyphs. Notice that the denticular architrave is composed of a single band crowned by a listel, while the mutular has two bands, of which the upper projects beyond the one that rests upon the capital. These bands are designated by the name fascia or "facure."

Both styles of Doric architraves are twenty-seven parts in height, of which four are given to the listel.

The lower band of the mutular Doric architrave is nine parts in height; the height of the guttae is three, of the reglet or "taenia" one. The denticular style has but one projection, that of the listel, which is three. The mutular has a projection of four, because of the added projection of the second fascia which is one. The guttae are spaced four parts from center to center; their lower width is three and the upper width two. The face of the taenia is parallel to the slope of the guttae. The projection of the guttae from the face of the architrave is 2.5 on the bottom, and two at the top.

56. The frieze of the Doric Order is thirty-six parts in height and is distinguished by its triglyphs, which are apparently the extremities of beams, forming on the frieze a slight projection of two parts, and spaced at regular intervals. The name comes from the triangular channels with which they are ornamented. The detail of this ornament as well as of the dependant guttae is clearly shown in Fig. 7.

57. The cornice of the denticular Doric Order is thirty-seven parts in height and its projection is forty. It is composed first, of a band four parts in height and one in projection, forming a slight projection of .5 over each triglyph; second, a cyma-reversa of three in height and 2.5 in projection, placed with a projection of five-tenths over the head of the triglyph; third, a band six in height and five-tenths in projection over the cyma-reversa; against this band are placed small blocks, five parts in height and four in width, with a space of two between them, which are called dentils; fourth, a corona eleven parts in height comprising two fillets, of one part each which are seen in profile on the section AA and which, with the drip, are intended to carry off the rain water; fifth, a cyma-

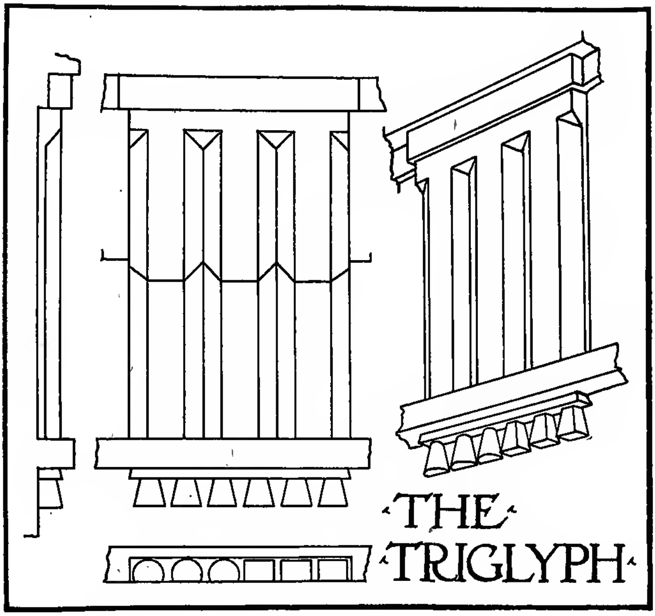

Fig. 7.

reversa of 1.8 surmounted by a fillet of 1.2 and the whole projecting 2.2; sixth, a cavetto of six, and six in projection; seventh, a listel of four crowning the cavetto.

58. The two sections show that the dentils are surmounted under the corona by a cavetto of two in height, having a projection of two in which is included the offsetting projection of .5. This cavetto causes the soffit or lower face of the corona to be inclined two parts. This soffit is divided into panels of various forms corresponding to the divisions of the frieze, as will be seen in Fig. 9. Those panels which correspond to the triglyphs are ornamented by round guttae, the position of which is determined by the edges of the channels. The guttae are three parts in diameter at the lower face and two at their summit; they are one in height and are placed in three rows spaced four from center to center. The other panels are divided into lozenges and triangles and are sometimes ornamented with rosettes or other devices.

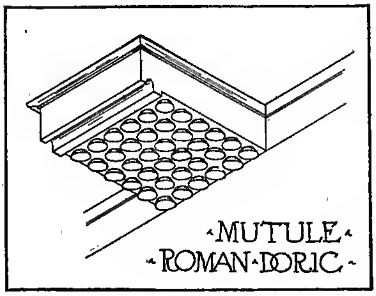

Fig. 8.

59. The frieze of the mutular order is distinguished only by a slight difference in the channels of the triglyph. The channels on the edges are eased off into a curve at the top, while the others form re-entering angles.

The cornice is noticeable for the projecting blocks which depend from the corona and which are called mutules (Fig. 8). This cornice (Plate V) has the same height as the preceding one (Plate IV), but it differs in its projection, which is forty-two. The height is divided in the following manner: the band above the triglyph four, the fillet 1.5, the quarter round three and five-tenths, mutules six and five-tenths, cyma-reversa one and five-tenths, the corona eight, cyma-reversa one and eight-tenths, fillet one and two-tenths, cyma-recta six, and the listel three. The projection is divided as follows: the thickness of the triglyph two, band and listel one, quarter-round three and five-tenths, the fascia five-tenths, mutules twenty-four and five-tenths, corona two and five-tenths, fillet projection with cyma reversa two, and the cyma-recta six.

The mutules have a face five and five-tenths in height and form a profile composed of a square of one, a drip of one and five-tenths, and a reglet of two. The lower face of the mutules in Plate V is decorated with five rows of guttae, six in a row. As the mutules correspond in their position and in their width to the triglyphs, so the divisions of the guttae correspond with the edges of the channels of the triglyphs.

60. In the Doric Order the axes of columns and pilasters always correspond to the axes of the triglyphs above them. The upper semi-diameter of the column being twenty-two, the axis of the first triglyph is placed at twenty-two from the angle. The triglyphs are twenty-four in width, and the spaces which separate them are thirty-six. These spaces are exactly square, having a width equal to the height of the frieze, and are called "metopes." The mutules are of the same width as the triglyphs, twenty-four, and are placed on the same axes. Sometimes the metopes are decorated with objects of sculpture whose character is suggested by the character of the edifice. (Plates VIII and IX.)

61. The under part of the corona, or "soffit" of the Doric cornice is divided like the frieze, its divisions corresponding to the triglyphs and the metopes, as we have already seen. The arrangement of the soffit at the angle must be carefully observed:—in the denticular cornice, Fig. 9, there is included in the corner a division which corresponds to the width of the metope: first, a division of five; second, a division of 13; third, another division of five; and finally—at the angle—a square of twelve and a fillet of one. These parts are decorated with panels where sometimes are placed rosettes, winged thunder bolts, or other ornaments in accordance with the character of the edifice. In the soffit of the mutular cornice (Plate IX) there is at the angle a square of twenty-three and five-tenths, decorated with a panel which may be filled with sculpture, such as the winged thunder-bolt. The space between this panel and the mutule is ornamented with lozenge shaped panel, in which is a rosette.

62. The cymatium or cap of the pedestal (Plate VI) is fourteen parts high, of which the divisions are: a fillet of one, quarter-round of three, corona of seven, and listel of three. Its projection is nine, of which four is the projection of the congé and quarter-round, three and five-tenths of the corona, and one and five-tenths of the listel.

The base of the pedestal is forty-five in height, divided among a first plinth twenty-five, second plinth ten, listel three, cyma-reversa five, and fillet two. The projection of the base is eight, of which one is for the first plinth, one for the second plinth, four for the cyma-reversa, and two for the congé. The die of the pedestal is eighty-one parts high and its sides are in plane with the faces of the plinth of the column base.

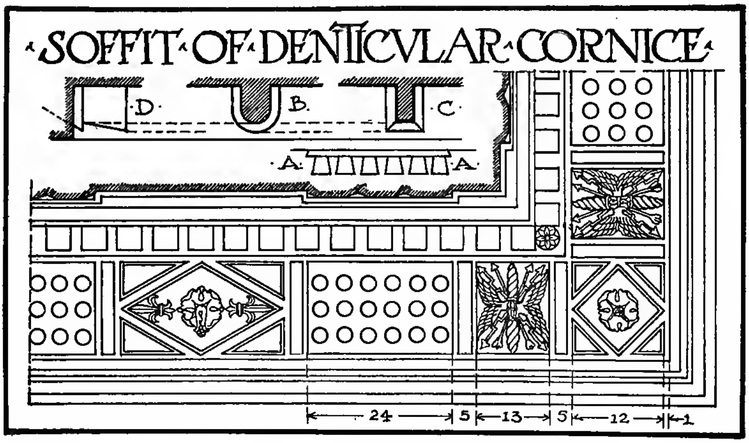

Fig. 9.

63. The impost is twenty-five in height; it is composed of an astragal of three, a necking of seven, a fillet of one, a quarter-round of three, a corona of eight, and a listel of three.

The projection of the impost is eight; for the quarter-round and fillet four, for the corona two and five-tenths, and for the listel one and five-tenths. The astragal projects two. The archivolt is thirty in height; it is composed of a first band nine, second band

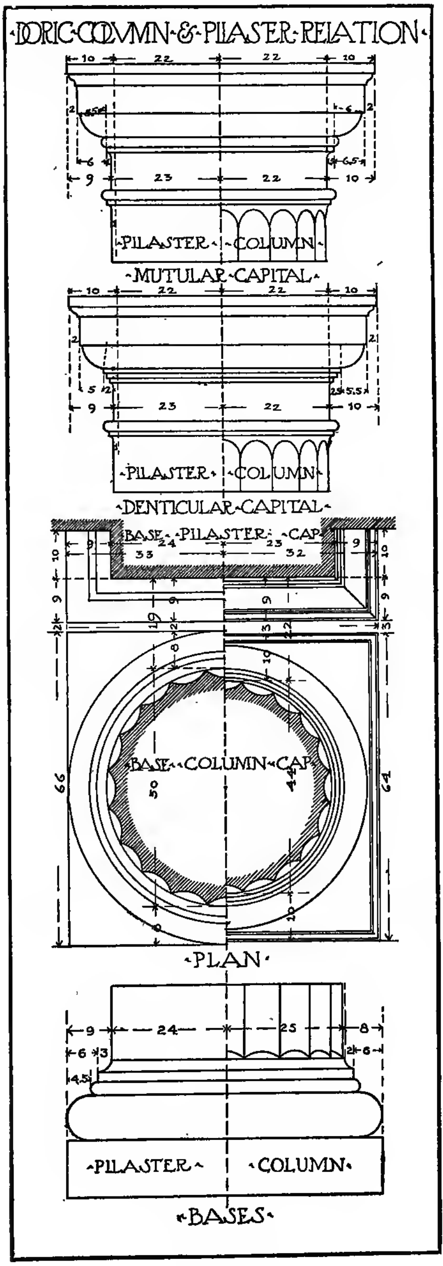

Fig. 10.

eleven and five-tenths, fillet one and five-tenths, quarter-round four, and listel four.

The projection of the archivolt is six; second band one, fillet one, quarter round three and five-tenths, and listel five-tenths.

64. The width of the Doric pilaster in proportion to the column is shown in Fig. 10. The lower diameter of the Doric column being fifty and its upper diameter forty-four, the difference is six, which is divided into three equal parts, of which one is taken for the difference in width between the neck and base of the pilaster, forty-eight being the width at the base and forty-six at the bottom of the cap.

The difference of projection of the bases is made up in the congé which projects two for the column and three for the pilaster.

The difference in the projection of the caps is made up in the three annulets and the quarter-round of the denticular capital and in the astragal and quarter round of the mutular capital.

THE IONIC ORDER.

65. The Ionic Order is distinguished principally by the form of its capital, of which the spiral scrolls, called volutes (Plate X) are the most important and determining characteristic.

66. The abacus of the Ionic capital is square; it projects six parts from the lower face of the architrave or from the upper diameter of the shaft of the column, is four parts in height and is composed of a fillet of two parts and a cyma-reversa of two. The fillet also has a projection of two. The upper face of the abacus forms a square of fifty-one on each side, and the lower face a square of forty-seven; the volutes grow from beneath the abacus on opposite sides; the catheti, which are the vertical axes or center lines of the volutes, are placed a distance of twenty-one from the axis of the column, or project one and five-tenths beyond its upper diameter. The height of the volute being twenty, the three following dimensions may be laid out on the catheti below the abacus; ten for the volute above the eye, two and five-tenths for the diameter of the eye, and seven and five-tenths for the lower part of the volute. The volute may then be drawn.

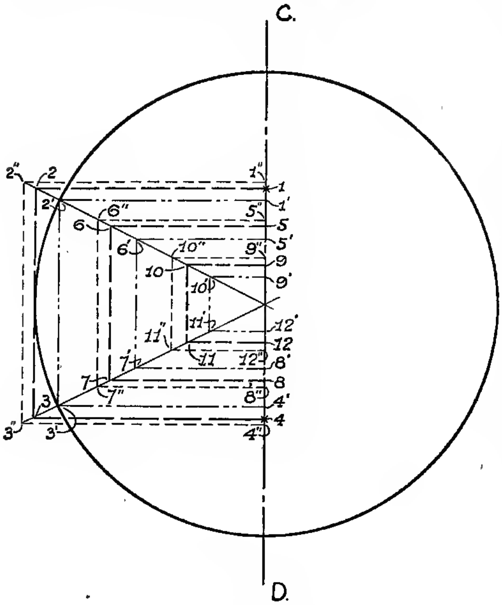

Fig. 11.

67. The spiral or volute is composed of twelve quarter circles drawn from twelve different centres, which may be located in the following manner. Having established, on a vertical line called the "cathetus," the height of the volute, twenty parts, it is divided into eight equal portions. The divisions are marked 1, 2, 3, 4, 5, 6, 7 and 8, commencing at the lower edge. Mark the middle of the space included between the points 3 and 4, and draw through this central point a horizontal line. Taking this same point for the center, draw with a radius of one-half part, a circle which will be the eye of the volute. This eye is shown enlarged in Fig. 11. Divide into two equal parts the two radii of the eye which coincide with the cathetus, C–D giving the points 1 and 4, and here construct a square of 1, 2, 3, and 4, in the direction in which the mass of the volute is to be drawn, in this case on the left of the cathetus. The side of this square which coincides with the cathetus being divided into six equal parts, the other two squares—five, six, seven, eight, and nine, ten, eleven, twelve—may be drawn. In this manner are obtained twelve center points at the corners of the squares, numbered from 1 to 12 from which are drawn the twelve quarter circles that constitute the exterior spiral. Horizontal and vertical lines from these twelve centres determine the limits of the twelve quarter circles.

68. In order to trace the second spiral which forms the inner edge of the fillet of the volute, divide into three parts on the cathetus (Plate X) the space included between the first and the second revolution, that is to say, the distance between the points six and eight. One-third of this distance 6-8 will be the width of the fillet. To find the twelve centers for the second spiral, draw three new squares of which the height and position are determined by dividing into thirds the space between the squares of the first spiral so that the new square 1′, 2′, 3′, 4′, (Fig. 11) shall be within the square 1, 2, 3, 4, by just ⅓ the distance from 1 to 5 and from 4 to 8. The new squares 5′, 6′, 7′, 8′, and 9′, 10′, 11′, 12′, will have corresponding relations to squares 5, 6, 7, 8, and 9, 10, 11, 12, respectively. From the points 1′ to 12′ inclusive, the second spiral may be drawn in the same manner as the first.

69. For the outer fillet, which appears below the abacus and beyond the cathetus, (Plate X) find four center points by constructing a new square larger than the square 1, 2, 3, 4, (Fig. 11). This is determined by taking on the cathetus C–D, half of the distance from the point 1 to the point 1′, and measuring this distance outside of the point 1 to the point 1″, from which 2″, 3″, 4″, etc., can be readily drawn.

70. The space included between the lower part of the abacus and the first complete revolution of the volute forms a flat band which ties together the two volute faces of the capital, and this band is set back two and five-tenths from the projection of the abacus. (See section through side of capital.) The fillet disappears in this face by a quarter of a circle drawn from the point six on the cathetus. The space between the lower line of this face and the horizontal line passing through the center of the volute eye is taken up by a quarter-round drawn with a radius of six and projecting four and five-tenths from the face of the volutes or eight from the outside of the shaft, as may be seen at B in the section on the right of the drawing of the "Side of the Capital." This moulding follows the circular plan of the shaft and is ordinarily decorated with eggs and darts. Below this quarter-round is found an astragal which unites the capital with the shaft; this astragal is three and five-tenths parts in height, of which two and five-tenths are for the bead and one for the fillet, the projection is two and five-tenths of which one and five-tenths is for the bead, and one for the congé.

71. The side face of the capital, called the "roll," unites the volutes of the two faces. It is forty-six parts in width and is divided in the center by a sunken band of six (or seven) parts in width which is ornamented with two bead mouldings of two parts each spaced one part apart.. The height of this band below the abacus is fourteen, as shown in the section; the space included between it and the return or inner edge of the face of the volute is sixteen or sixteen and five-tenths. This part is bell-shaped, and its outline is obtained on the side of the capital as follows: Having prolonged the horizontal line marking the lowest point of the volutes, find on it two points, the one, two and five-tenths from the band at the center, the other five and five-tenths from the inner edge of the volute, and here erect two perpendiculars; on the first of which mark heights of four and five-tenths, and of eight and five-tenths, and on the second three and five-tenths, and nine and five-tenths. Four points *a*, *b*, *c* and *d* will be obtained by this means through which the curves may be readily drawn.

The section of the roll may be drawn thus: Draw the profile of the abacus and of the astragal. Then draw the exterior contour of the volute as far as its intersection with the line of the shaft, by establishing the cathetus and the first three points of the squares 1, 2, 3, and 1″, 2″, 3″ in the eye. Draw a horizontal line *e f* marking the height of the center of the roll, fourteen parts below the abacus, and another horizontal three parts higher up. On the latter horizontal fix a point *h* six and five-tenths from the edge of the volute; from this point, with a radius of three, a semi-circumference may be drawn whose intersection with the horizontal *k* gives the center of the second arc of the section, which may be drawn with a radius of six. Then continue the lower line of the abacus and mark a point *o* three and five-tenths beyond its projection; this is the center of a third arc of the circle which may be drawn with a radius of seven.

72. The principal figure of this plate (X) is the plan of the capital, which shows the horizontal form and the disposition of the rolls, as well as the combination of the circular mouldings with the square mass of the capital.

73. The Ionic capital is generally enriched with carved ornaments, the quarter-round is carved with eggs and darts, the bead of the astragal is carved with bead and reel ornaments and the roll is carved with leaves, more or less detailed, while a rosette is frequently carved in the circle forming the eye of the volute.

74. The channels of the Ionic column differ from those of the Doric in the fillets which separate them; they are shown in this plate to be twenty in number, and the width of the fillet is equal to one-third of the width of the channel, so that, after having divided the circumference of the shaft into twenty equal parts, each of these is divided into eight, two of these eight parts being given to the fillet and six to the channel.

The plan of each channel is drawn from a center placed at a distance of one part outside of the circumference of the shaft, as is shown in the plate. (Plate X.)

75. The number of flutings of the Ionic shaft is frequently twenty-four instead of twenty, as here shown. In the attempt to differentiate between the Ionic and Corinthian capitals it is often desirable to allot a smaller number of flutings to the Ionic shaft. When this order is used at a small scale, it is very proper that the channels should be few in number, so as not to complicate the carving. For use in wood, however, twenty-four channels, with their centers placed on the line of the column circumference, are preferable, as they are sharper, more effective and better accord with the accepted number of seven flutings for the pilaster shaft.

The flutings as shown in plan on Plate X are very shallow and do not "tell" as much as should be expected of this method of ornamenting the column. It is therefore suggested that in actual practice the method and number of flutings shown on the plan of the Corinthian shaft, Plate XIX, be also employed on the Ionic.

76. The cornice of the Ionic order (Plate XI) is less complicated than that of the Doric, having, with the exception of the dentils, none but horizontal divisions. The cornice is forty parts in height and its projection is equal to its height.

Certain of the mouldings are carved with the leaf and tongue, the egg and dart, and the bead and reel, the perpendicular divisions of which correspond to the axes of the dentils, which in turn correspond to the axes of the columns. The frieze is thirty parts in height and undecorated; the architrave is the same height as the frieze, and is composed of three bands or fascias and a crowning moulding. The band which rests on the capital is six in height and its face is plumb with the upper diameter of the column and with the frieze; the second band is seven parts in height and projects one part beyond the lower; between the second and third bands occurs a cyma-reversa two parts high; this third band has a projection of one and five-tenths beyond the second. The assemblage of mouldings crowning the architrave is composed of a bead moulding of one and five-tenths parts, and a cyma-reversa of three, crowned by a listel of two and five-tenths. The projection of these mouldings beyond the third band is three and five-tenths, so that the extreme projection of the architrave is six.

77. The base of the Ionic order (Plate XII) is twenty-three and five-tenths parts in height; it is composed of a plinth of eight, a first torus of six, a fillet of one and five-tenths, a scotia of three, a second fillet of one, and a second torus of four. The projection of the base, including the congé of the shaft, is eight, of which two is the projection of the congé. This is shown on the enlarged section of the pedestal and column base at the left.

78. The cymatium or cap of the pedestal is fourteen in height, divided as follows: a fillet, one and five-tenths, cyma-recta, two and five-tenths, surmounted by a small fillet of five-tenths, a corona of five and five-tenths, a cyma-reversa of two, and a listel of two. The projection of the cap from the plinth of the column base and the die of the pedestal is nine, of which two parts are for the cyma-reversa and listel, and three and five-tenths for the corona in which is cut a small drip. The base of the pedestal is forty-five in height divided thus: first plinth, twenty-five; second plinth, ten; torus, three and five-tenths; fillet, one; cyma-reversa, four; upper fillet, one and five-tenths. The projection of the base is eight, of which one is for the congé, four for the cyma-reversa, two for the torus, and one for the first plinth.

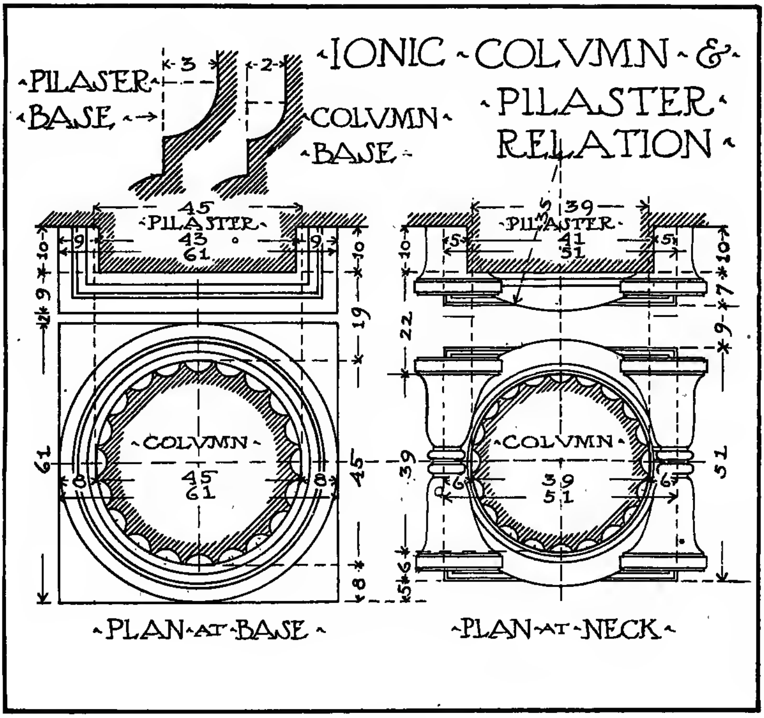

Fig. 12.

79. The impost is twenty-three parts high and is sub-divided as follows: astragal three; frieze six and five-tenths; fillet one;

quarter round, two and five-tenths; corona, six; cyma-reversa, two; listel, two. The projection of the impost is eight; two for the cyma and listel, three for the corona, and three for the quarter-round and fillet. The archivolt is twenty-five in width composed of a first band of seven, a cyma of two, a second band of nine, a bead of one and five-tenths, a cyma of three, and a listel of two and five-tenths. The projection of the archivolt is five, of which one and five-tenths is for the projection of the second band beyond the first, one for the bead, and two and five-tenths for the cyma and its fillet.

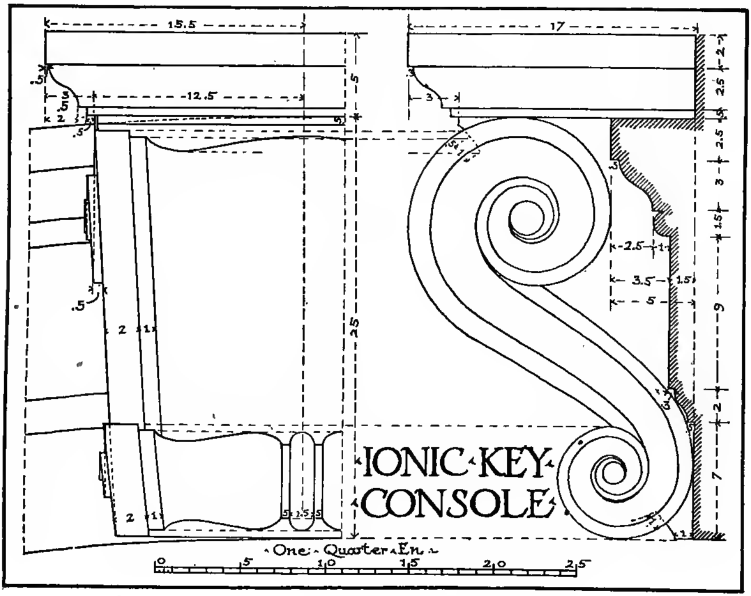

Fig. 13.

80. The relation of Ionic column taper to pilaster taper (Fig. 12) is as follows: The lower diameter of the Ionic column is forty-five, and its upper diameter thirty-nine, the difference is six, which, divided into three parts, as in the Doric order, gives for the lower width of the pilaster forty-three, and for the upper width forty-one. The projections of the bases differ only in the congé of the shaft which measures three for the pilaster and two for the column.

The disposition of the capital is the same for the pilaster as for the column so far as the volutes are concerned, the catheti being the same distance (forty-two parts) from each other. It may be noticed only in the plan of the capital of the pilaster, that the outer edge of the quarter-round forms an arc of a circle drawn with a radius of thirty-five, while the astragal is rectangular in plan like the face of the pilaster, and, running between the volutes, connects them with one another.

81. In Fig. 13 will be found a drawing of the Ionic console. Sometimes one of these consoles is placed at the crown of an arch intersecting the archivolt. The sides of such a console radiate from the center of the arch; the stone on which the console is carved is called the "key" of the arch or the "keystone."

THE CORINTHIAN ORDER.

82 The Corinthian is an elaborately formal and dignified Order, and all the details which enter into its composition will bear analyzing with the greatest possible care.

83. The Corinthian capital (Plate XVII) is in form similar to a cylindrical vase covered by an abacus with hollowed sides and with corners cut at an angle of forty-five degrees, in plan with the sides of the square containing the abacus. Against this vase or "bell" are placed two rows of leaves whose heads are curved. The first row, which is applied directly above the astragal of the shaft, is composed of eight leaves; these are called the small leaves. From the intervals between these small leaves arise the stems of the second row of leaves which are larger. Between these large leaves and just over the centers of the small ones, eight stems arise, from which develop eight other leaves which, divided into two parts, recurve above the large leaves at the corners of the abacus and at the center of each of its faces. These leaves, which are very much distorted, are called caulicoli. From these caulicoli arise sixteen volutes of which eight large ones unroll in pairs, back to back, under the corners of the abacus, and eight small ones, also in pairs, extend towards the centers of the four sides of the abacus. Among the small volutes next to the bell is placed an ornament which is called the floweret, and above this, against the mouldings of the abacus, is a rosette.

84. The small leaf, Plate XVI, is placed on a vertical axis against the vase in such a manner that the base rests on the astragal and its face corresponds to the face of the shaft, so that, the leaves being one part thick at the bottom, the vase of the capital must be two parts smaller than the column at the neck.

The sweep of the leaf has a projection of six from the base and forms a delicately curved profile the shape of which may easily be determined from the plate. The squares represent a unit of two parts in all cases.

The developed width of the leaf is equal to its height, thirteen parts. It is represented in front elevation, half developed to its full height, and half in its recurved position as it is placed on the capital. The developed half shows the under part of the curved top; it may be seen that a perpendicular axis divides the leaf into two perfectly symmetrical halves, each half being divided into four divisions which themselves are sub-divided—the topmost and lowest ones into four pointed lobes, the two others into five.

Notice that in order to present the ordinary profile above the astragal, the leaf preserves its entire mass in the lower part for a small distance above the base.

85. The large leaf, (Plate XV) which grows from above the astragal, in the small space between two of the smaller leaves, (see Plate XVII) projects nine parts beyond the upper diameter of the shaft. Its details are in almost every particular similar to those of the small leaf.

86. The stems of the caulicoli (Plate XVI) are channeled batons or staves each crowned by a calix from which the distorted leaf or caulicolus springs (Plates XV and XVI.)

87. It may be noticed that in the direct elevation (Plate XVI) the enrollments of the volute are arranged in the form of a cork-screw, and the section shows the manner in which their faces are hollowed out. The floweret (Plate XV) is seen only in direct elevation in the general plate, being attached to the vase on the axis of each space between the smaller volutes. It is shown separately on this plate, with a horizontal section.

88. This same plate shows the detail of a rosette having six divisions, in the center of which is found a slug whose tail is turned upward.

89. The upper part of the Corinthian capital is a drum in the form of a bell whose upper edge is decorated with a curved moulding called the lip. The bell is forty parts in height; its lower diameter (directly above the astragal of the column) is thirty-four, —two parts less than the neck of the column,—and its upper diameter at the edge of the lip is forty-four. This difference of diameter forms a section or outline starting at the astragal and extending in a delicate curve up to the edge of the lip.

It is against this vase or bell that all the ornaments that have been detailed are attached. In order to draw each one in its own place in the general elevation—after having made the section, or profile, of the bell, with the astragal of the shaft—mark on a vertical line the height of the small leaf, thirteen parts; above this the height of the large leaf, twelve; then the distance above the large leaves up to the volute, six; next mark the height of the turn-over of the small and the large leaves, four; and the turn-over of the caulicoli, three and five-tenths. Through all these different points draw horizontal lines across the width of the bell. All the projections are figured from verticals erected from the face of the column above the astragal. The small leaf projects six, the large one nine, the leaf of the caulicolus fifteen and five-tenths, and the volute seventeen.

90. In order to draw the elevation of the Corinthian capital it is necessary to consider first its outline as a section, and to lay out carefully, in plan, the arrangement of its leaf ornaments, as shown in Plate XVII. By means of this section and plan, the elevation may be exactly determined, after the individual parts, with their arrangement, are thoroughly understood.

91. The capital of the pilaster is composed of the same elements as that of the column; but as the plan of the pilaster is square the forms are slightly different; thus the vase, which is square at its base above the astragal, has convex faces; each face of the vase has two small leaves square in plan, and centering on perpendiculars at a distance of nine from the center line. Larger leaves are placed in the center of each face and at each angle. The abacus and other details are exactly similar to those of the capital of the column.

92. The Corinthian architrave (Plate XVIII) is thirty parts in height and divided into three bands; the first, five and five-tenths; second, six and five-tenths; and the third, seven and five-tenths. Between the first and the second there is a bead of one; between the second and the third, a cyma of two; above the third face there is a bead of one and five-tenths; cyma-reversa, three and five-tenths; and a fillet, two and five-tenths. The total projection of the architrave from the frieze is five and five-tenths.

93. The frieze has the same height as the architrave, and is terminated against the cornice by an astragal of one and five-tenths, of which five-tenths is for the fillet and one for the bead.

94. The Corinthian cornice has a total height of forty parts and its projection is equal to its height. It is divided thus: first, a cyma of three; second, a flat band of six and five-tenths, against which is placed a row of dentils five and five-tenths deep; third, an astragal one and five-tenths; fourth, a quarter-round three and five-tenths; fifth, a flat band of seven, against which are placed modillions six and five-tenths parts deep; sixth, a cyma of one and five-tenths which is mitred around the modillions and which crowns them; seventh, a corona of seven; eighth, a cyma of one and five-tenths; ninth, a fillet of one; tenth, a cyma-recta of five, and a fillet of two and five-tenths.

The total projection of forty is divided as follows: four parts for the cyma, four for the dentils, five for the astragal, the quarter-round, and the flat band of the modillions; eighteen for the modillions up to the lower angle of the cyma; one for the cyma reversa; one for the corona; two for the upper cyma and its listel; and five for the cyma-recta.

95. The cornice of the Corinthian order is distinguished by the consoles which support the corona and which are called modillions. The modillion is composed of two volutes or spirals similar to the keystone which we have already analyzed in Fig. 16, but while in the keystone the large spiral is found at the highest part, in the console it is at the back and attached to the face of the cornice.

The lower side of the modillion is covered by an ornamented leaf, whose head curves back against the smaller volute. The general proportions and curves of this leaf are indicated in Plate

XVIII. In practice, the console is drawn free-hand after laying out the general proportions.

The modillions are nine parts in width and are spaced seventeen and five-tenths apart or twenty-six and five-tenths from center to center; the dentils are four parts wide and are two apart. Against the cyma-recta very frequently is placed a row of masks in the form of lions' heads to serve as water spouts. These masks occur over the center of the modillions.

The soffit of the corona is ornamented between the modillions, with panels containing rosettes. (Fig. 14.)

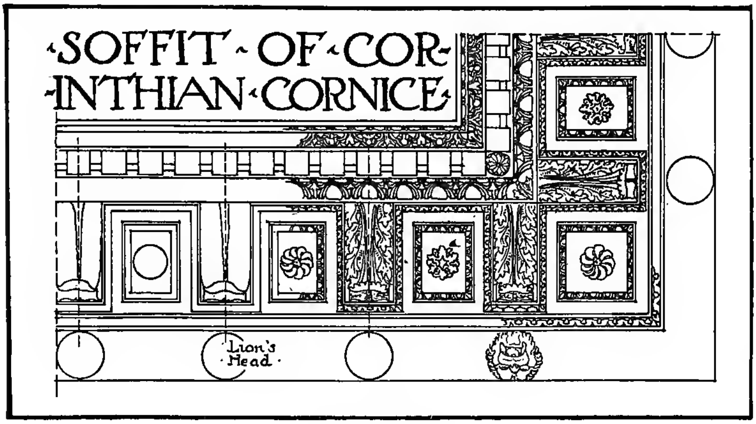

Fig. 14.

96. The base of the Corinthian Order (Plate XIX) is composed of a plinth, two torus mouldings, and two scotias separated by a double bead. Its total height is twenty-three, of which seven and five-tenths is for the plinth; five and five-tenths for the first torus; one for the fillet; one and five-tenths for the first scotia; two for the beads and their annulets; one and five-tenths for the second scotia; five-tenths for its listel; and three and five-tenths for the second torus.

The total projection of the base is eight; in this is included the congé of the column whose projection is one and five-tenths.

97. The cap of the pedestal is twenty parts in height divided among an astragal of two, a small frieze of five and five-tenths, second astragal of two, a cyma-recta of two and five-tenths, corona of five, a cyma-reversa of one and seven-tenths, and a fillet of one and three-tenths. The total projection of the cap from the die of the pedestal is eight.

The base of the pedestal is forty parts in height; it is composed of a first plinth of twenty-four, a second plinth of six, a torus of three and five-tenths, a reversed cyma-recta of three and five-tenths, with a fillet of one, a bead one and five-tenths, with a fillet of five-tenths. The total projection is seven and five-tenths, of which one is for the first plinth.

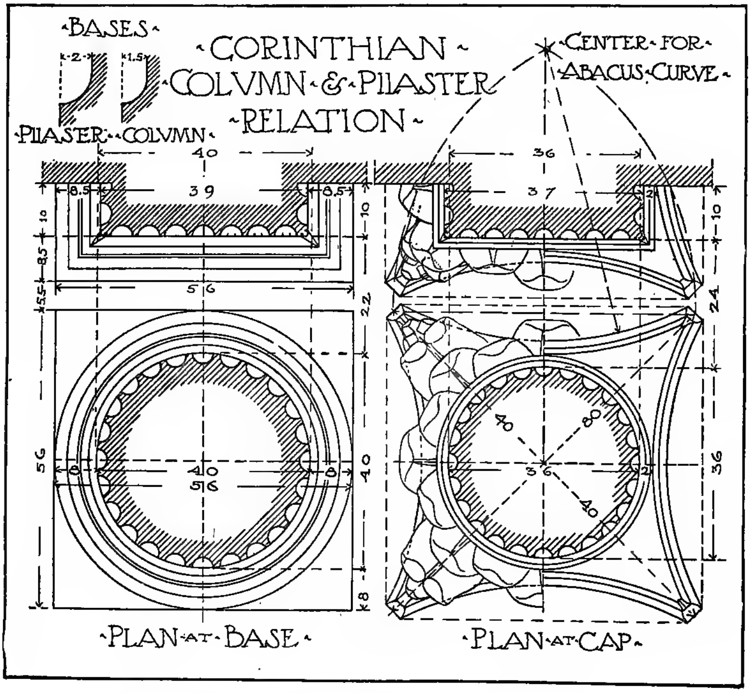

Fig. 15.

98. The impost is twenty parts in height and is composed of an astragal of two; frieze, five and five-tenths; fillet, five-tenths; bead, one; quarter-round, two and five-tenths; corona, five; cyma-reversa, two; and listel, one and five-tenths.

The total projection of the impost is seven, but for the arches between which a column with a pedestal is used, there is a greater projection of the corona of the impost. In this case the impost projection is eight.

99. The archivolt is composed of three fascias, a bead and quarter-round with a fillet, and a cyma-reversa with fillet. Its width is twenty-two parts; the first fascia four; bead one; second fascia five; fillet five-tenths; quarter-round one and five-tenths; third fascia six and five-tenths; cyma two; and fillet one and five-tenths. The total projection is four.

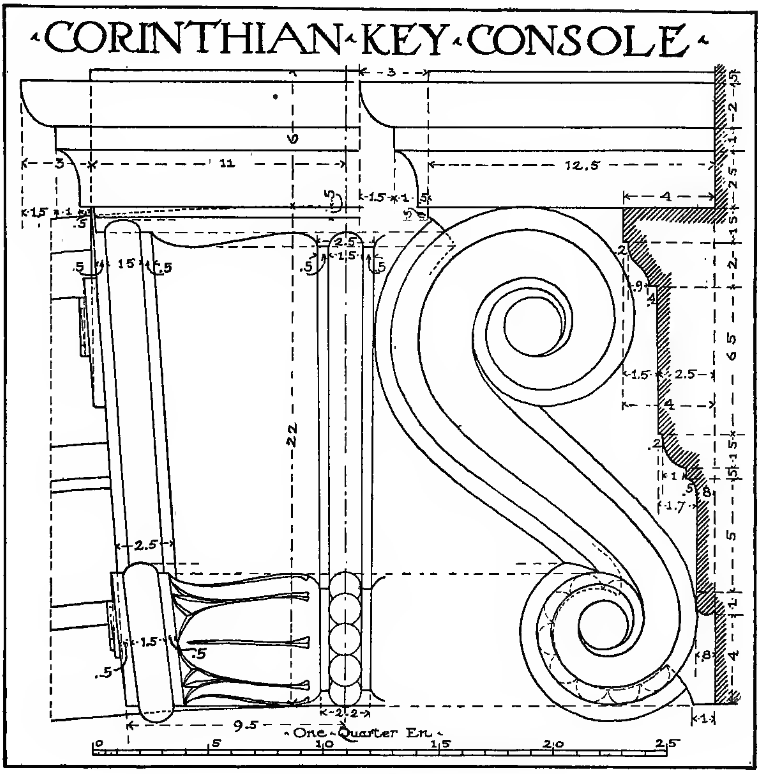

Fig. 16.

100. The channels of the Corinthian column are twenty-four in number. The width of the fillet which separates them is one-third of the channel width. The width of a pier of the arcade is equal to the width of a column plus two archivolts which is eighty-four parts.

101. The Corinthian pilaster and column relation is shown in Fig. 15: the pilaster width at the base is thirty-nine; at the height of the capital it is thirty-seven. The width of the pilaster differs from the diameter of the column, being one part less at the base and one more at the height of the capital. The base of the pilaster projects eight and five-tenths so that the total width may be equal to that at the base of the column. The width of the abacus of the pilaster capital is equal to that of the capital of the column.

102. When the pilaster is channeled, there is formed at each angle a bead of one part and the remaining width is divided into twenty-nine equal spaces which in turn are divided into seven channels of three spaces, and eight fillets of one space each. The summits and the bases of the channels correspond to the starting point of the congés.

This rule for fluting of columns and pilasters is also applicable to the Ionic Order.

103. The drawing of the keystone console of the Corinthian arch as shown in Fig. 16 is a little different from that of the Ionic Order, but is drawn in accordance with the same rules.

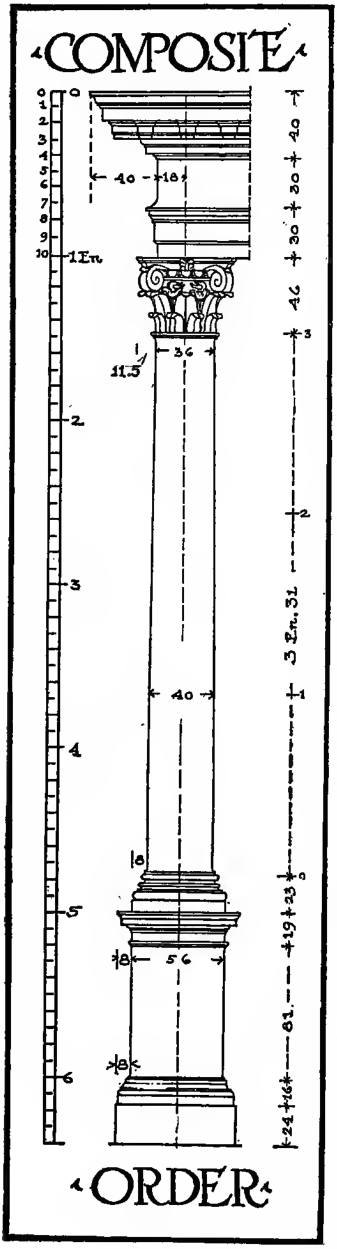

Fig. 17.

THE COMPOSITE ORDER.

104. The Composite capital (Fig. 17) is a mixture of elements of the Ionic and Corinthian capitals. Its forms and general proportions are like those of the Corinthian Order. There are two banks of leaves placed as in the Corinthian, but the upper part is in the form of an Ionic capital whose volutes are placed on the angles.

105. The general proportions of the Composite entablature are the same as those of the Corinthian, but their details are appreciably different in the cornice, where the modillions are replaced by a sort of double mutule having two fascias.

106. We have now arrived at the close of the analysis of all the details which enter into the composition of the three Orders of Classical Architecture, and it will be advisable to take up briefly the consideration of their use in relation to each other, especially in regard to the principles governing their intercolumniation and superposition.

INTERCOLUMNIATION.

107. Intercolumniation is the spacing of columns *in the clear*, especially of columns arranged in the form of a colonnade. When a figured dimension refers to the spacing it is invariably one diameter less than the distance from center to center of columns.

108. Superposition has reference to the use of the orders in two or more stories, when certain general principles always apply, as will be shown.

109. A colonnade is a row of columns spaced regularly and connected by an entablature. The space which separates these columns is called the intercolumniation. When the colonnade is composed of two or more rows of columns and the space which they enclose is covered and serves as a covered porch or entrance to a building, this porch is called a portico, and it is often crowned with a gable or pediment above the columns. Usually one side of a portico is closed by a wall, and sometimes three sides are so closed; in such a case the columns at the angles are replaced by pilasters to which the side walls are attached. Pilasters which are employed in this manner are called antae, and a portico of this kind is a portico "in antis." The term "antae" is more generally employed in Greek work and the term "pilaster" is used in Roman architecture.

110. When the portico is employed as a porch in front of an edifice, the columns are generally of an even number, and the spaces of uneven number, in order to have a space in the center opposite the door-way of the building. Even when an entrance is not placed behind the center of a colonnade it is considered in better taste to place the columns or arches so that a support does not come in the center of any such arrangement. When a pediment is placed over columns this rule is even more strictly followed. Occasionally, usage determines that the intercolumniations of a portico shall be unequal so that the central opening may be wider than the others, in order that the approach to the entrance to the building may be more ample.

111. The intercolumniation of the Roman Doric order is determined more or less by the fact that the columns are invariably placed directly under the triglyphs. It will be found difficult to space two columns under two adjacent triglyphs, because the bases and caps of the columns will overlap each other. Still, they may be so placed by enlarging the spaces between the triglyphs or reducing the projection of the cap and base, or both. It is not often that circumstances would justify such an alteration in the order to effect a close spacing of columns. When the columns are set under alternate triglyphs they are spaced about two and one-half diameters on centers. The intercolumniation is then one and one-half diameters, or as it is termed "monotriglyphic" or "pycnostyle," (Fig. 18). The width of the intercolumniations (spaces between columns) of a portico should seldom be less than one and one-half times the diameter of the column, and in old work it will rarely be found to exceed two and one-half diameters. In modern practice as in exceptional cases in

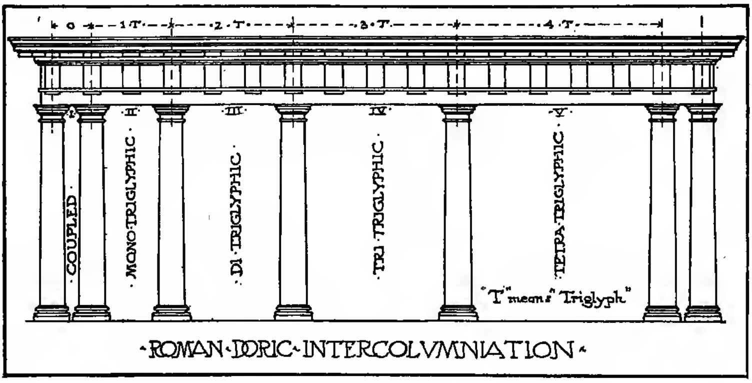

Fig. 18.

ancient work, this spacing is, however, exceeded. When two triglyphs occur over the opening between the columns the intercolumniation is about two and three-fourths diameters, and is called "ditriglyphic." Too great an intercolumniation produces a bad effect in all the orders. However, when the order is executed in wood a much wider spacing is often employed.

112. In the spacing of columns other than in Doric Order there is no such special requirement as to the location of the column under any particular part of the entablature, although where modillions or brackets are used they should be so spaced as to come over the axes of the columns. Such modillions or brackets are, however, easily varied slightly in spacing or location, so that the system of intercolumniation in any other than the Doric Order is generally determined only by the diameter and height of the columns themselves. Columns are referred to as "coupled" when they are so placed that the bases or caps just avoid touching. This would space them about one-third to one-half their diameter apart, which is the least spacing that the outline of the column itself will allow. The various spacings of columns are generally termed coupled, pycnostyle, systyle, eustyle, diastyle, and arœostyle according as they are placed close together or are separated by 1, 1½, 2, 2¼, 3 or 4 diameters. (Fig. 19.) The spacing of the coupled

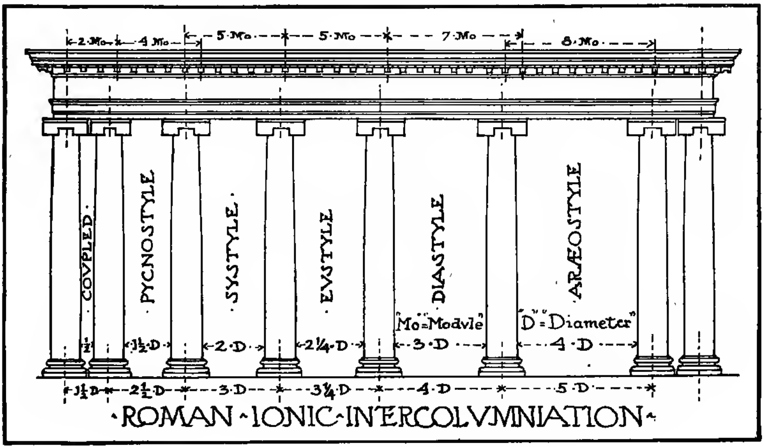

Fig. 19.

columns we have already explained. The pycnostyle intercolumniation varies from one and one-quarter to one and one-half diameters. The systyle intercolumniation has two diameters which·in modern work would often seem too little. The eustyle has two and one-quarter diameters between the columns; or, as is sometimes preferred in modern practice, two and one-third diameters as in the Ionic and Corinthian orders. This corresponds more exactly to the customary spacing of dentils and modillions.

113. Closer intercolumniations are generally used on monumental work of large scale, while that of a more domestic character requires a wider spacing of columns for practical utilitarian purposes. During the Renaissance, the custom of placing columns in couples and taking each couple as a unit for working out the colonnade, was first adopted and has since, especially in France, been much employed. In modern practice the columns are placed less by rule than to satisfy the eye and the judgment of the designer. It must be remembered, however, that the axes of the columns must always be in accord with certain members of the entablature above, such as the triglyphs, dentils, or modillions, and also that, under a pediment, the columns themselves should be even in number.

114. A portico forming the front facade of an edifice, when there are not more than seven intercolumniations, may be crowned by a triangular gable or pediment which forms the roof of the porch.

115. A pediment is placed above the cornice of the entablature and is formed by two sloping cornices which are joined at the angles to the horizontal cornice. The crowning cyma-recta or cavetto follows the sloping cornice and is omitted from the horizontal cornice below the face of the pediment. The triangular face which is found between the three cornices corresponds in plane with the frieze of the entablature and is called the "tympanum" of the pediment.

The height of a pediment is determined as follows. In Fig. 20 let A be the point in which the axis of the pediment intersects the highest line of the horizontal cornice. With this point as a center and with a radius equal to one-half the width of the pediment, draw a semi-circle below the pediment as shown in the figure. This semi-circle intersects the axis of the pediment at the point B. With B as a center and with a radius equal to the distance from B to C (the extreme outside point of the horizontal cornice) draw an arc above the cornice. The point D, in which this arc intersects the axis, will be the highest point or "peak" of the pediment. Draw the lines DC and DE and the outline of the pediment will be complete.

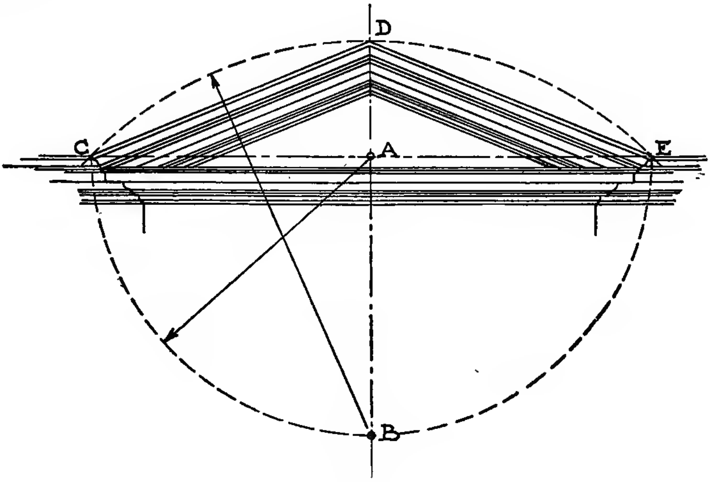

Fig. 20.

In plate XXXIII is represented a portico of the Ionic Order with three intercolumniations which forms the front of an edifice intended for a hall or temple. The plan is a parallelogram of which the front or portico occupies one of the smaller sides.

SUPERPOSITION OF THE ORDERS.

116. The principles governing superposition, or the use of orders one above the other, as we find them in many of the Roman and Renaissance buildings, is that the natural method is followed in placing a lighter and apparently more delicate order above one of greater strength. For instance, the Tuscan should never be other than the lowest order, and the Doric should be placed above this. As we have already seen, however, the Tuscan Order may better be omitted and the Doric Order may be placed in the lowest story with the Ionic and Corinthian above in the order named.

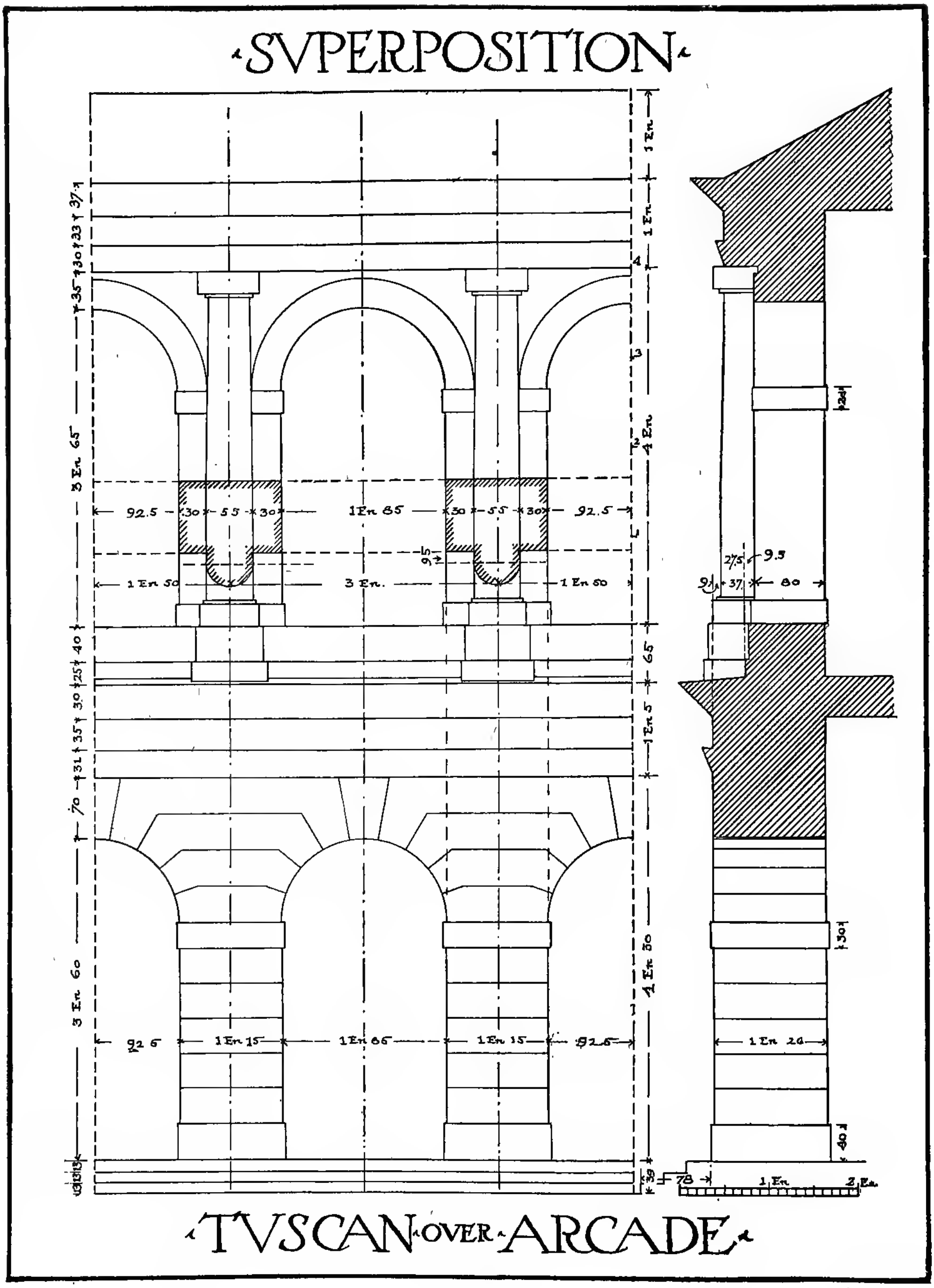
SVPERPOSITION
TVSCAN OVER ARCADE
1 En
1 En
4
3
2
4 En
1
37
23
30
35
3 En 65
92.5
30
55
30
1 En 85
30
55
30
92.5
1 En 50
3 En.
1 En 50
5
9.5
27.5
9.5
9.5
37
80
24
40
25
30
35
31
65
1 En 5
70
3 En 60
4 En 50
92.5
1 En 15
1 En 85
1 En 15
92.5
1 En 24
30
40
13
13
13
39
78
1 En
2 En

Fig. 21.

117. It sometimes happens that the same order is employed in two different stories, in which case the upper example should be more slender and of less diameter than that below. This rule holds good for any superposition of the orders. Usually the base diameter of the shaft above is the same as the diameter at the neck of the shaft below. In section, or in side elevation, it is the practice to make each order recede slightly from the face of the one below. In other words, the base or square plinth beneath the column in the upper story should be plumb with the face of the frieze of the order of the story below. This gives an appearance of stability which is quite appreciable and prevents the upper orders from seeming to overpower and overweigh the orders below.

118. If columns are coupled and set exactly over each other, there is slight tendency for the space between the columns in the upper story to seem too wide. This may be avoided by taking the center line of the space between the lowest couple and then draw the columns in toward each other on each successive story; keeping them in the same relation to each other and equally spaced on each side of the center line.

119. Facades of edifices of two stories sometimes have an order occupying the whole height of the upper story, the lower story being treated as a pedestal for this order. An example of this combination is seen in Fig. 21. The lower story or ground floor, raised on three steps, is composed of an arcade crowned by an entablature to which may be applied the details of the Tuscan order. Above this entablature is a Tuscan or a Doric order with arches whose axes correspond to those of the lower arches. This order is raised on a double plinth which forms the base of the arcade.

120. The use of an order in the upper story of a two-storied facade offers few difficulties and generally produces a good effect; the proportional height of the base to the order which surmounts it depends entirely on the height of the stories. In this plate the height of the ground story of the facade has been assumed to be six entablatures of the second-story order.

121. The succeeding plates offer an opportunity to study the various methods and combinations in which columns attached to a wall, and called "engaged columns," are used. Such columns were much employed by the ancient Romans in a manner which modern architects have frequently imitated. The engaged columns form a projecting part that in certain instances adds greatly to the perspective effect of a facade, and sometimes serves also as an additional support; but in many instances pilasters would be preferable, especially on the angles of a building. The columns are generally engaged in the walls for from one-third to one-quarter of their diameter.

122. The Romans have also left famous examples of superposition of the orders in the facades of their theatres and amphitheatres, although such a combination is not considered as effective as an order superposed on an arcade, as in Fig. 21.

123. It has been explained that the lower order in a superposition should be a little larger than the one next above it. In Fig. 22 the height of the upper columns is three entablatures seventy-five parts of the lower order, whose columns are four entablatures in height (as is shown by the figures at the left-hand margin).

The same rules have been observed in the two exercises that follow. The Ionic order, placed above the Doric in Fig. 23 is a little smaller than the Doric; the height of the column being but three Ens seventy-five parts of the lower order. The Corinthian column placed on the Ionic in Fig. 24 has but three Ens seventy parts of the height of the Ionic. This will give in each instance for the column of the upper order a lower diameter that is substantially the same as the upper diameter of the column over which it is placed. At the same time the height of the second story, as well as the arches and column there used, is reduced proportionally, unless the column shafts be attenuated beyond the rule here employed

124. Taking the height of three entablatures and seventy-five parts of the first story order, for the total height of the columns in the second-story order in Fig. 22 by re-dividing that height into four parts, it is easy to ascertain the height of the second-story entablature in relation to the column with which it is used.

125. In elevation it will be seen that the piers of the second story (Fig. 22) are not as wide as those of the story below,

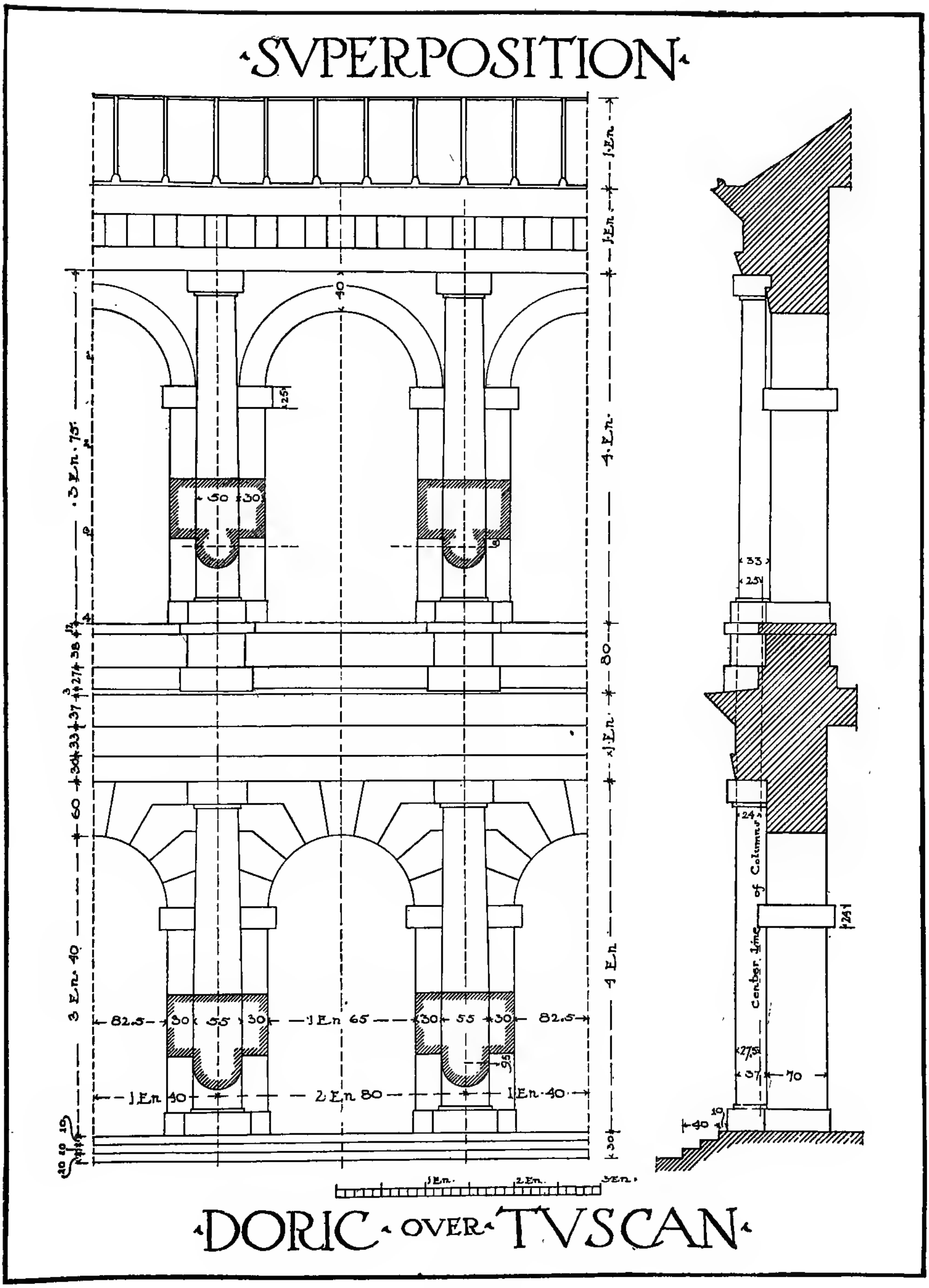
SVPERPOSITION
1 En
1 En
4 En
80
1 En
4 En
30
40
25
50
30
3 En 75
12
38
27
3
37
33
30
60
3 En 40
82.5
30
55
30
1 En 65
30
55
30
82.5
95
1 En 40
2 En 80
1 En 40
10
10
10
20
20
33
25
24
24
Center line of Columns
27.5
37
70
10
40
1 En
2 En
3 En
DORIC OVER TVSCAN

Fig. 22.

by an appreciable amount. Although the figures given show a difference of only five parts, it must be remembered that the unit employed in the upper order is smaller than that used in the lower story, and therefore the difference is somewhat more than that which the actual figures suggest.

126. By referring to the section (Fig. 22) it will be seen that in this example the second-story column shaft at the base, lines with the frieze and column shaft at the neck of the order below, while the second-story pedestal and column base project beyond this line. This arrangement allows the center line of the second-story column to be over the center line of the column below.

127. In Fig. 23 another method is followed; here the face of the pedestal or die of the second-story order is placed in plane with the frieze and column neck below, when it becomes impossible for the center line of the columns to coincide; there being, as shown by the dotted line in the section, a difference of eight parts between these center lines.

128. In Fig. 24 again, we find that the base of the shaft of the second-story order lines with the neck of the shaft below.

129. Where a pedestal is given to a second-story super-imposed order, except under exceptional circumstances, the method shown in Fig. 23 would probably be most certain of making a favorable impression upon the observer, although it might be possible that a compromise between the methods shown in Figs. 23 and 24 would better solve the problem. Such a question must be decided by the judgment of the designer. It might be said, however, that where the second-story column is placed upon the entablature of the first-story order without the interposition of a pedestal, the best effect would invariably be obtained by directly lining—in section—the face of the foot of the second-story column shaft with the face of the neck of the shaft below.

130. The facade shown in Fig. 22 is composed of two rows of super-imposed arches, one of the Tuscan and the other of the Doric Order, each pier carrying on its face an attached column shaft.

The Doric Order is raised on a support forming a pedestal and having a cap and base.

131. Fig. 23 is a facade of two stories, with the Ionic Order placed over the Doric Order. The columns are engaged in the

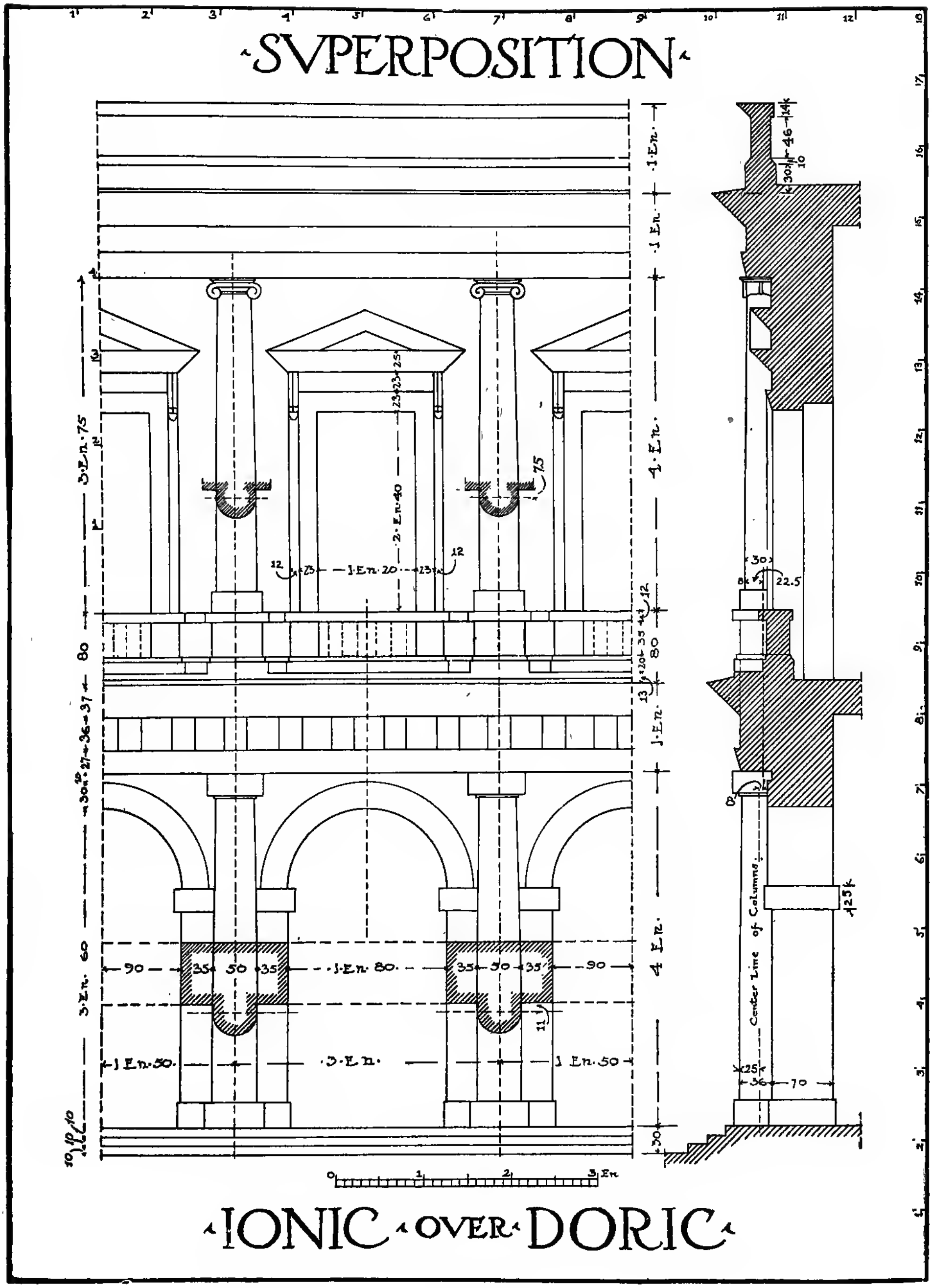
SVPERPOSITION
IONIC OVER DORIC
1·En·
1 En·
4·En·
3·En·75
2·En·40
1·En·20
23
12
75
80
1·En·
4·En·
90
35
50
35
1·En·80·
90
3·En·60
1·En·50·
·3·En·
1·En·50
30
30·27·36·37
0
1
2
3 En
14
46
30
10
30
22.5
8
Center Line of Columns
25
36
70
25

Fig. 23.

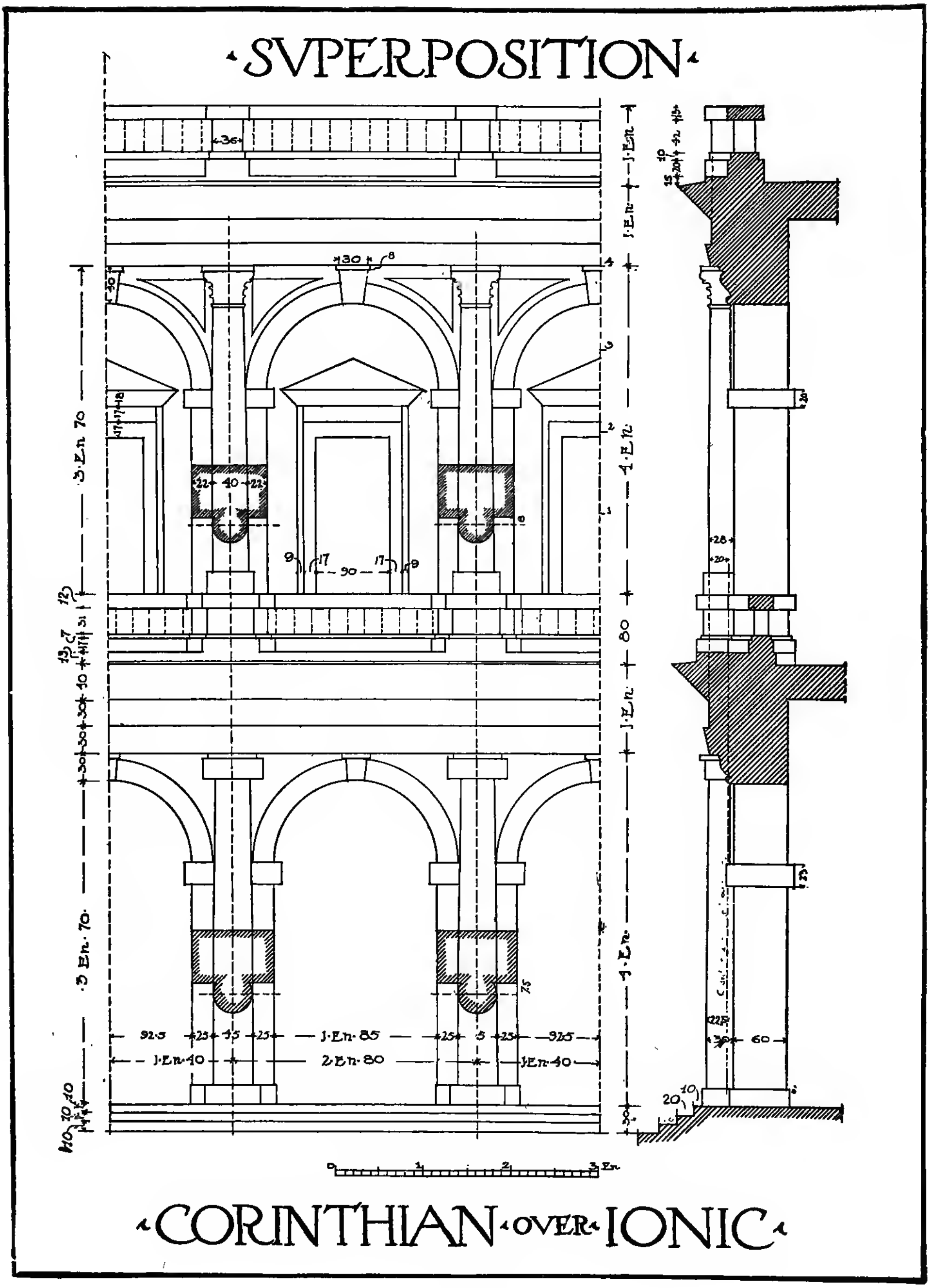
SVPERPOSITION
1·En
1·En
3·En 70
4·En
1·En
3·En·70·
4·En
92·5
1·En·85
92·5
1·En·40
2·En·80
1·En·40
0 1 2 3 En
CORINTHIAN OVER IONIC

Fig. 24.

wall which is pierced with arches between the lower columns, and with rectangular windows between the upper columns. The windows are ornamented with frames or architraves with an outer pilaster finish carrying consoles, the whole being surmounted by an entablature with a pediment. The details of these parts should be taken from the examples of similar details shown in Plate XXVIII.

The support or pedestal of the Ionic Order forms a balustrade in the bay of the window.

132. In Fig. 24 is shown a section of a facade of two stories where the Ionic Order is used with the Corinthian above it. The columns are placed between arches, forming an arcaded gallery. The windows shown are found in the wall at the back of the gallery, and the upper entablature is surmounted by a parapet wall or balustrade.

EXAMINATION PLATES

133. The student who has followed closely this analysis with its application, will have an intelligent knowledge of the Orders, and may put his knowledge to practical use in the exercises which follow.

IN GENERAL.

In laying out, from the descriptions and plates, the various problems which follow, some differences from the proportions already given may occasionally be found. These differences, in all cases attendant upon some ethical reason or principle of the problem involved, must be understood by the student before he attempts to apply the theoretical knowledge of the orders already acquired. Then, from the general dimensions given to determine the proportions of the problems, he will find it possible to complete the design by the application of the various details shown in the preceding plates. These exercises require the application of what the student has previously learned, to actual—if academic—problems, while they will also serve to illustrate such details as the proportions of arcades and openings, and the spacing of columns and of piers.

134. These exercises must be drawn out in pencil before inking in any parts of the drawing. The plan is the prime essential and should be first determined and drawn out. In starting a drawing, either in plan or elevation, the general principles given in paragraphs 5, 6, 9, 10, and 11 should be observed. The center line or axis must first be established in order to determine the relation and the placing of the drawing upon the paper.

135. The dimension figures given throughout these exercises may be omitted from the drawing; but all the lettering, both large and small, must be included. The plate must be signed and dated in the lower left or right-hand corner, and sent to the School for correction and criticism. The plates must be taken up and drawn out in the order given and the first plates submitted when three are completed in order that the student may profit by the instructor's corrections as he progresses with his work.

The Examination for this Instruction Paper consists of fifteen plates, which should be sent to the School in six instalments:

1st Instalment	A, B, and C,	4th Instalment	I, J, and K,
2nd “	D and E,	5th “	L and M,
3rd “	F, G, and H,	6th “	N and O.

Each Instalment should be sent as soon as completed.

The paper for these plates should be purchased in sheets 22 inches × 30 inches. (Imperial size). Some of the plates are to be 11 × 15 inches ($\frac{1}{4}$ of Imperial size) with border line $\frac{1}{2}$ inch inside, making panel 10 inches × 14 inches. Others are to be 13 × 18 inside of border line, for which use $\frac{1}{2}$ an Imperial sheet; while a few will require the whole sheet and should be 20 inches × 28 inches inside of border lines.

PLATES A AND B.

136. These exercises are shown in Fig. 4 and Plate II respectively. Fig. 4 should be drawn to the size shown in the margin, each unit representing one inch. Therefore the finished plates will be 10″ × 14″ in size. Plate B should be an accurate copy of Plate II. Leave out dimensions.

PLATE C.

137. The sheet of mouldings shown in Fig. 5, is to be redrawn on a plate whose border line is 10″ × 14″. The names of the mouldings with the general title of the plate should be lettered in, following as closely as possible the model illustration.

PLATE D.

138. Draw a plate to the border-line size of 10″×14″ and arrange after the manner shown in Plate VIII, assembling the various details of the Doric Order shown in Plates III, IV, V and VI, and following the measurements for the separate parts therein given. The placing of these details on the plate, with their relative size, lettering, etc., is to be as shown in the model, Plate VIII. Either the Mutular or the Denticular Order may be drawn out, as the student may prefer.

PLATE E.

139. The Ionic Order is to be drawn and the finished plate is to correspond in appearance and arrangement with the model, Plate XIII, and is to follow the construction and proportions given in plates X, XI and XII.

PLATE F.

140. The Corinthian Order is to be drawn so as to resemble the model, Plate XXI, and is to follow the measurements, proportions, etc., of Plates XVII, XVIII and XIX. Plates XV and XVI should assist materially in understanding the method of drawing the Corinthian capital shown in Plate XVII.

PLATE G.

141. The arched doorway of the Denticular Doric Order, shown blocked out in rough outline in Fig. 25, is to be drawn to follow the general dimensions, and to include all the details given in the plates of that order. The border line should be 20×28 inches in size.

The width of the archway is two and one-half entablatures, and the columns, from center to center, are three entablatures and sixty parts apart. The heights, and the placing of the plan and elevation on the plate, will all be easily ascertained by following the inch units shown against the border line, Fig. 25.

PLATE H.

142. The archway of the Ionic Order shown in Plate XXII is to be redrawn with the same outline size as in Plate G. The width of the Ionic arch is two and one-quarter entablatures, and

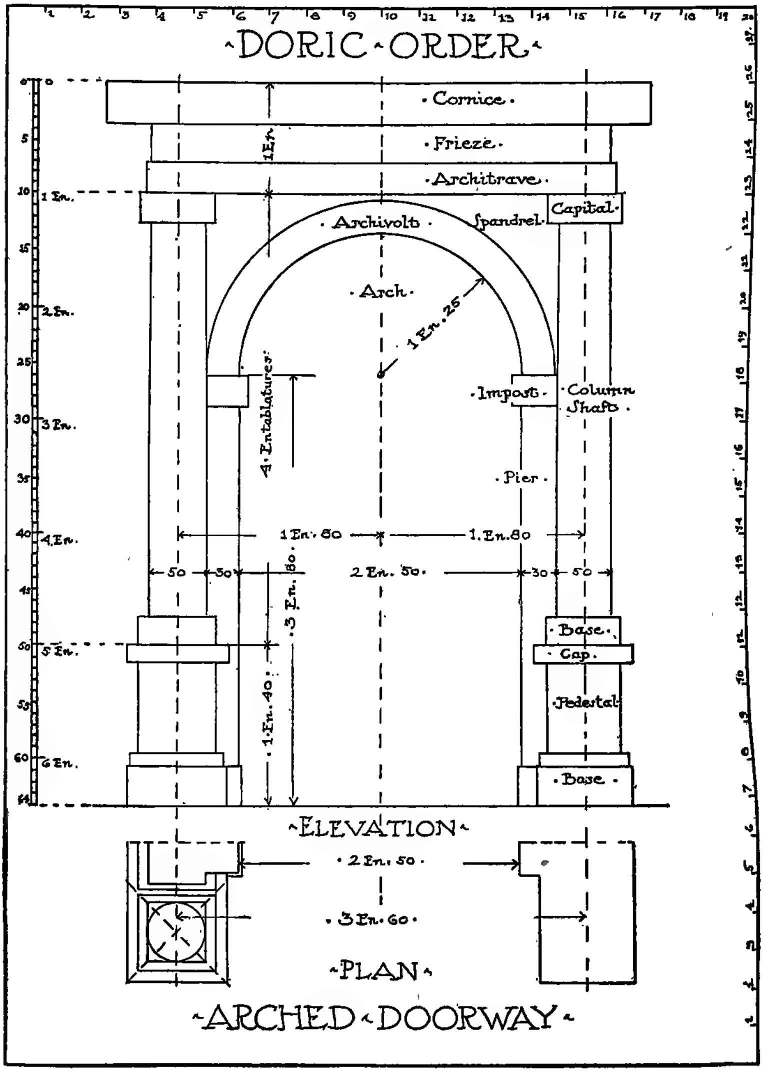

Fig. 25.

its height is equal to twice its width, an accepted general rule for proportioning arches. The archway is ornamented with two columns placed before pilasters, which are in turn set against the face of the piers.

Apply to this exercise all the details of the preceding studies in the Ionic Order and draw out, as shown in this plate, the plan, the half elevation, and the section.

PLATE I.

143. As an application of the study of the Corinthian Order, draw out an archway similar to that of the Ionic Order just described. The drawing should show a plan, section, and half elevation, but should follow the proportions and dimensions given in the plates of the Corinthian Order. The columns are spaced about 3 entablatures and 40 parts and the center of the archivolt is occupied by a keystone ornamented with the console shown in Fig. 16.

This problem is exactly like the problem of the arched doorway in the Ionic order except for the fact that the proportions and details are those of the Corinthian Order. The distance 3 En.-40 from center to center of the columns is the only dimension given for this plate. The student is expected to obtain all the other necessary dimensions from his study of the preceding plates.

144. In drawing this problem, which will be on a smaller scale than the Corinthian Order plates drawn before, the student should pay particular attention to the proportions of the parts. Some little difficulty may be experienced in laying out the smaller members. While at such a scale it may seem impracticable to draw these members in their true relative size, still, the general proportions of the details of the order may be clearly indicated, if carefully studied and drawn. The sheet should be 20″×28″. This size is given so that the student will experience as little difficulty as possible with the smaller members and still have the drawing of a convenient size. Begin by drawing a vertical center line and on each side of this lay out the center lines of the columns.

PLATE J.

145. This exercise requires that the student use the Tuscan Order shown in Fig. 6, and the details shown in Plate II. This order is required because it will be found easier to use in these early problems on account of the large scale of the mouldings and the few lines required in their delineation. It is to be drawn out to the size of 13″×18″ and is to follow in appearance and arrangement, Plate XXIII. On this plate the plan is completely shown, while the elevation is merely blocked out in the rough, in order that the student in completing it may have independent practice in the use of the order.

This problem displays the inner corner of a square or rectangular court yard, which is surrounded by an arcade composed of the Tuscan pilaster and archway. The floor of the gallery is raised three steps of fifteen parts each, above the level of the court.

146. The gallery is vaulted with semi-circular vaults; that is, vaults whose form is a semi-circumference. A vault formed of a semi-circular arch, without penetrations throughout its whole length, is called a barrel vault. Two vaults of the same radius which intersect each other form what is called a groined vault, because of the hips or groins which mark their intersection. The vaults over this gallery are barrel vaults, which, by their intersections at the angles as well as by the penetrations of the barrel vaults which correspond to the arches of the gallery, form groined vaults. The dotted diagonal lines on the plan show the groins of the vaults. The width of the gallery is two entablatures and forty parts, this width being equal to the distance between the pilasters of the facade. The groined vaults are separated by a space of fifty-five parts, that is, a distance equal to the width of the pilaster.

PLATE K.

147. This exercise is to be drawn out at the same size as the one just given, 13″×18″, and the plate numbered XXIV is to be accurately copied. The subject of this exercise is a gallery in the Doric Order with arches, surrounding a court or garden. The arches rest upon piers, decorated on their faces with a couple of pilasters spaced under alternate triglyphs. The space between the pilasters, occupied by the arches of the arcade, is determined by the spacing of the triglyphs, four of which occur over the arches. These pilasters are repeated in the interior of the gallery, which is covered by a flat ceiling, supported by an entablature whose details are shown on the lower portion of the plate. The ceiling over the corner is separated from that of the rest of the gallery by entablatures and arches resting on pilasters advancing from the faces of the corner piers. This combination is shown in dotted lines on the plan. The gallery arches are repeated on the blank wall which encloses the gallery. The exterior entablature is surmounted by a plain parapet or balustrade, as the roof of the gallery is flat and would be accessible from the second story of the edifice.

PLATE L.

148. This exercise is fully drawn out in Plate XXV, and should be copied by the student at the same size as the ones just preceding. In this example we have shown a gallery with colonnade; no arches being employed in the problem.

Here we have another possible treatment for a gallery sursounding a court or garden. It is that of a portico or colonnade, with a flat ceiling, the angles being strengthened by square piers, against each face of which a half pilaster is placed. This causes two pilasters to occur in line with the columns, and the other two to face toward the interior of the gallery, with two other half pilasters projecting from the surrounding walls, opposite them. The architrave of the connecting entablature forms a soffit between them, as the dotted lines of the plan indicate.

149. The surrounding walls are pierced by doors on the longitudinal axes of the gallery. These doors are surrounded by moulded architraves and crowned by entablatures or door caps. A wainscot, or dado, is formed by a string course ornamented with a Vitruvian scroll or wave (this is the term applied to the ornament whose detail is given on this plate at E). A plinth, or base, corresponding in height to the base of the column, runs around the walls; its crowning moulding being formed of the fillet and bead of the column base. The astragal of the capitals also continues around the walls, which, in addition, are decorated with panels intended to receive mural paintings. The flat ceiling, or soffit, of this gallery is similar to that of the preceding exercise and is supported or surrounded by the same entablature. The sloping roof is formed of sheets of zinc or lead corresponding in width to the spacing of the triglyphs, and with lips or rolls formed by the interlocking edges of the sheets. On the same axis with each lip is an antefix placed above the cornice, and shown in detail at F on this plate. In the cornice is formed a gutter for the removal of rainwater.

PLATE M.

150. The student is required to design an arcade and gallery using the Ionic Order. This gallery is to be similar in treatment to the one shown in Plate XXIII, where the Tuscan Order is employed. The plan of this gallery is shown in Fig. 26, while a perspective sketch of the spring of the arches on an interior angle is shown in Fig. 27. On the plan is indicated in dotted lines the form of the arching ceiling over this gallery. It is simply described as a barrel vault with the penetration from each side of arches of a less height and radius. The perspective sketch shows the method of treating the impost moulding on the interior, breaking it around the various pilasters forming the corner pier. On the exterior, the entablature is crowned by a balustrade composed of balusters similar to those shown in Plate XXXIV. The plan will give the width of the arched openings which, as we have already seen in other examples of the Ionic Order, are in height twice their width. This will determine all the remaining proportions of the exercise, which is to be drawn of the same dimensions as the preceding plates, 13×18 inches.

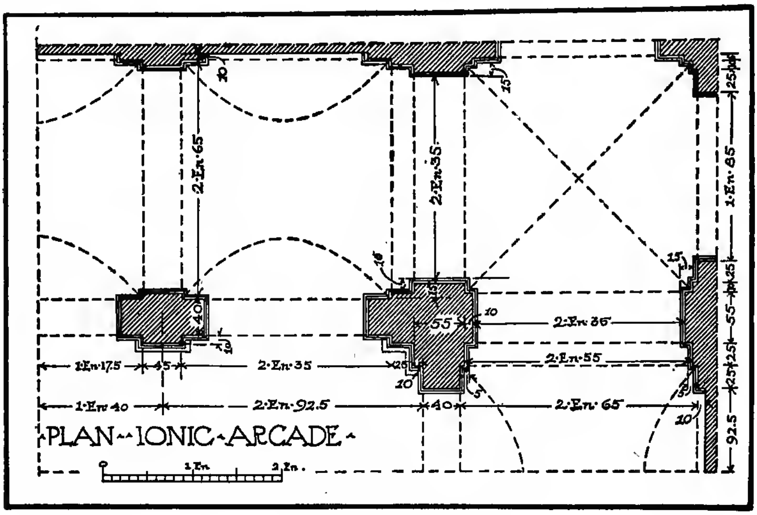

Fig. 26.

PLATE N.

151. In Plate XXVI the Corinthian Order is used for ornamenting the final or crowning story of a Campanile or classic belfry. This problem is simply that of the arch placed between columns, which we have already seen in Plate I; the entablature being crowned with a pediment and such other modifications being made as the problem suggests. The student is required to draw out this plate at the same size as those preceding, 13″×18″, or if he desires he may substitute the Ionic Order and adapt its proportions and details to the same plan.

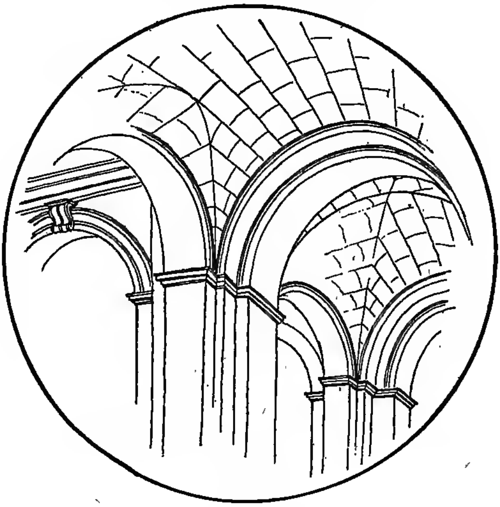

Fig. 27.

This upper portion of a Campanile may belong to a church, a city hall, or any other important edifice. The four facades are the same; each is composed of an arch flanked by two pilasters, carrying an entablature, a pediment, and a parapet. Each facade makes a projection from the mass of the tower. The four pediments penetrate the plain parapet which will, in turn, be surmounted by a roof or cupola. The interior is covered by a dome with pendentives (see paragraphs 157-158).

PLATE O.

152. Plate O is shown in Plate XXVII. This exercise requires merely the application of the arch and column of an arched doorway of the Tuscan Order to an actual problem; in this instance, arbitrarally termed a "guard house," the student is required to arrange his drawing on a sheet of the same size as in the previous example, and as shown in this plate. The plan and details being given, he must draw out the elevation.

153. The central part of the plan in this exercise is a porch, with arches, giving access by three doors to rooms placed on each side of the entrance, and to a hall or larger room at the rear.

154. We have called this problem a guard-house, because the disposition of the plan and the architectural character of the facade are well adapted to a problem of this character. The edifice may be completed by adding to its depth two pilasters or bays on each side, two entablatures and seventy parts (2 En. 70) apart from axis to axis; and in this way the lateral facade would be composed of three bays between pilasters, with an opening in each bay; the part added to the plan forms a large hall to which the door placed at the back of the porch gives access. This hall would then be lighted laterally by two windows on each side. The principal facade has a projection formed by two columns placed on pedestals and backed by two pilasters.

All the unanalyzed or new details of the Tuscan Order used in this exercise are shown at a larger scale on this plate. The interior entablature of this problem is the same as the exterior.

This concludes the required Examination; the remaining plates are given as a guide for students desiring to do further work by themselves.

PLATE P.

155. The entrance pavilion in the Ionic Order, shown in Plate XXVIII, is a problem similar to the one that has just been taken up. The student is required to reproduce this plate at the large size to which he has already drawn Plate O, with border line of 13×18 inches.

The small edifice is such as might be used at the entrance to certain public buildings, its plan—the same as that of the guard house—being composed of a porch with a room upon either side. One of these rooms might be the lodge for a porter, the other might be a ticket office. One quarter of the plan only is given as the arrangement is the same on the other sides of the axes.

156. The front is composed of three divisions separated by columns or pilasters. In the center is the archway of the porch and at each side is a window whose sill is supported by consoles, and surmounting the outside frame are consoles of a different character which support the cornice and pediment. These details are shown in A, B and C on this plate. The same details may be applied to the door of the porch.

The windows at the side are similar to those on the principal elevation. The entablature is surmounted by a balustrade divided by pedestals carrying vases; the details of these balusters and of the vases are shown on this plate.

157. The porch is square in plan but has a ceiling or "cupola" in the form of a dome or spherical vault; that is, the ceiling has the shape of a segment of a sphere, whose radius is 2-En and 20 parts, as shown in the sectional elevation in Plate XXVIII. This kind of ceiling requires explanation. The ceiling must be supported on the walls of the porch, which is square in plan, but the domical ceiling is circular in plan; therefore a horizontal section of the porch at the point where the walls end and the ceiling begins will show a square for the section of the walls and a circle for the section of the ceiling. These two geometrical figures must be joined in some way so that the walls will support the ceiling and the ceiling cover all the space enclosed by the walls.

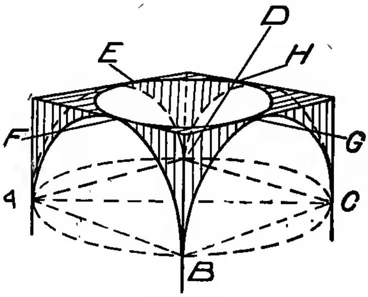

Fig. 28.

Whenever a square space is to be covered by a dome, the semi-diagonal of the square may be taken as the radius for the circle which forms the base or springing line of the dome. Fig. 28 shows at A B C D such a square and circle. If the four walls which form the sides of the square building are now continued upward, they will cut into the spherical segment whose base is represented by the circle, since this circle overhangs the square on all four sides. The figures cut from the domical surface by the walls will be segments of circles,—the intersection of a plane with a segment of a sphere. These segments of circles are shown in plate XXVIII as the semi-circular arches of radius 1-En and 50 parts, which cover the doorways. A horizontal section taken through the dome at the elevation of the crowns of these circular segments will show a circle which (in plan) will be inscribed in the square formed by the four walls, as shown by the smaller circle E F G H in Fig. 27. This circle is also shown dotted in the plan in Plate XXVIII.

The spherical surface which forms the ceiling of the porch has now been cut into, *first* by the four walls as they are continued upward from the springing line (A B C D) of the dome, and *second*, by a horizontal plane (E F G H) passing through the crowns of the four arches cut from the sphere by the walls. All that is left of the spherical surface is a triangular segment E D H in each corner. This portion of the ceiling is called the pendentive. In Plate XXVIII an elevation of the pendentive is shown at P.

158. The horizontal plane at the crowns of the arches cuts out from the spherical surface a circle (E F G H), which may now be covered over by a dome, or segment of a sphere, which may spring directly from it. In Plate XXVIII this circle is represented in elevation by the first horizontal line of mouldings above the arches. In this particular case, the domical ceiling or cupola does not spring directly from this circle but a small cylindrical band, or entablature, is built up above it for a height of 90 parts, from the top of which the ceiling springs.

PLATE Q.

159. The subject of this exercise (Plate XXIX) is a commemorative chapel of the Denticular Doric Order, and is to be drawn at the size indicated—13″×18″. This is the first of three exercises where a dome plays an important part in the exterior effect of an edifice. In any study, in elevation, of a building employing a dome or cylindrical story, it must be remembered that, in perspective, that portion which is circular in plan looks considerably smaller with reference to the square base from which it springs, than it does in any elevation,—on account of the difference in plan between a square, and a circle which is contained within such a square;—in other words, the circle remains of the same diameter if seen from any point; while an object square in plan, seen from any other position than in direct elevation, has its width considerably increased by the projecting corners.

160. The plan of the chapel is a square, having on the side of the principal facade, a projection formed by two columns placed upon pedestals and enclosing an arch whose proportions are like those of Fig. 25, this projection being crowned by a pediment. The opposite side has a semi-circular projection, in which is located a niche in which the altar may be placed.

161. The entablature surrounds the entire building, but the triglyphs are found only beneath the projecting pediment of the main facade. The building itself is surmounted by a low attic in the form of a plain parapet, above which are two steps forming a base for the domical roof.

162. The interior of the chapel is a square with its floor raised three steps above the exterior level. In the corners are pilasters forty parts in width and fifteen in projection; these pilasters, and also the entablature which surmounts them, are repetitions of the exterior order. The ceiling is a semi-circular vault or dome.

163. At the side of the facade is indicated the commencement of a retaining wall, with a grille, which might be continued to enclose a plot of land.

PLATE R.

164. Exercise R is a circular temple (Plate XXX, and plan Fig. 29) with a pedimented porch or portico, showing the use of the order set upon a dado around the interior walls. The ceiling is domical, with an opening in the center, and is ornamented on the under side by a series of recessed panels called caissons or coffers. This plate, like the one preceding, is to be drawn at the size of 13×18 inches.

165. Plate XXX shows an Ionic portico or porch attached to an edifice circular in form. The circular hall is six entablatures twenty parts in diameter, and the thickness of the wall is fifty parts. The perimeter of the hall is divided by pilasters of a smaller order than that on the exterior into twelve bays, as shown in the plan in Fig. 29. The difference in size is due to the pedestal, ninety parts in height, on which the pilasters are placed.

The scale for this interior order is obtained by dividing the total height of the pilaster and its entablature into five parts (each part representing one entablature of the interior order).

166. This circular hall is covered by a spherical cupola or dome, divided into caissons or coffers, the drawing of which constitutes the most interesting part of this exercise; it will therefore be explained as clearly as possible. It is illustrated on Plate XXX.

167. The projection of the interior pilasters being ten parts (at the scale of that order) from the face of the wall, the interior diameter of the springing of the cupola is six entablatures. Draw a half plan of the cupola, dividing its circumference into twelve equal parts and then draw the radii; lay off on each one of these radii, outside the circumference, the profile of a rib and the two coffers one on each side of the rib, each eighteen parts wide, and the two coffers seven parts each and three parts in depth. Next draw in on the plan two semi-circles, one of three entablatures and three parts radius, the other of three entablatures six parts radius. Having thus established the whole profile of the springing of the cupola, draw from each division a radius to the center; then show above this plan, centering on the same axis, the section of the cupola, whose center will be found forty parts below the first horizontal course. This height of forty parts forms a congé with an astragal above the cornice. The cupola is divided into five rows of caissons whose height is relative to their width. Notice that the first band above the astragal is fifteen wide; draw the vertical line from the point A (section) to the point A (plan); draw the quarter circle A which intersects at E and F the lines of the rib. Take from the plan the width EF and lay it off from A to B along the curve on the section, thus obtaining the height of the first row of caissons. From the point B (section) draw a vertical to B′ (plan) and draw the quarter circle through B′ in plan intersecting the radii at G and H. This distance (G H) laid off along the curve from B to C shows the width of the second horizontal band. Now project the point C (section) to C′ (plan) and draw the quarter circle C′ on which C′ D′ will give the height of the second row of caissons which will be laid off from C to D along the curve in the section. Continue this operation up to the fifth row of caissons. As to the widths of the coffers, they are found on the plan of each row of caissons and consequently diminish gradually with them. The profile of the caissons is formed in the section in this way and their location is found in plan. From each angle of the profile of the caisson draw a horizontal line through the section; this will give the horizontal lines on which all the points of intersection will be found in projecting the verticals from the corresponding points in the plan. Thus, from the point I (plan) which is found on the upper line of the topmost row of caissons, draw a vertical up to the point I (section) which is on the corresponding line in the section; from the point J (plan), which is found on the lower line of the same row of caissons, draw a vertical to the point J (section). Thus the circle I (plan) is represented in the section by the horizontal line I; the circle J, in the plan, by the horizontal J in section, the circles K, L, M, and N in plan by the horizontals K, L, M, and N of the section. The points of intersection of the radiating ribs in plan with the circular segment I, should be projected vertically to the horizontal I in the section. Those of the circle J, to the horizontal J; those of the circles K, L, M, and N, to the corresponding horizontals in the section. In this manner on each horizontal of the section, are found the points by means of which the curves of the bands may be drawn.

168. To draw the elevations of the stones of the circular part, it is necessary to show their location in plan, and, starting from the semi-pilaster which forms the junction of the portico with the circular walls, the stones are of the same length as those of the straight wall at the back of the portico. For the dentils of the circular cornice, the divisions in plan must also be made. The plan of this temple is shown in Fig. 29.

PLATE S.

169. In Plate XXXI is shown a temple that is entirely circular in plan and surrounded by a circular colonnade of Corinthian columns. The ceiling of the domed interior is similar to that of the building shown in Plate XXX, while the ceiling of the narrow porch outside the wall of the building is ornamented with coffers or panels, as is shown on the plan below. This temple is also to be drawn out to the size of 13×18 inches.

170. The axis of the colonnade is a circle of a radius of three entablatures and twenty parts, this circle being divided into twenty equal parts which give the spacing of the columns. The width of

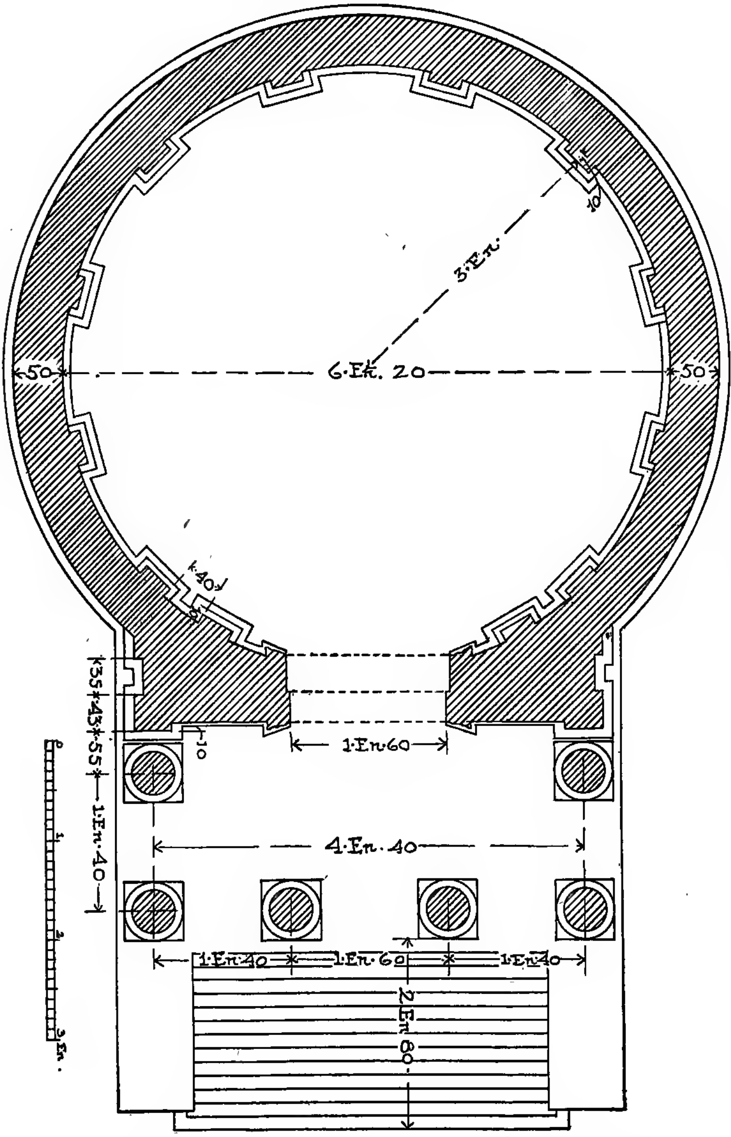

Fig. 29.

the portico, from the axis of the columns to the circular wall which is thirty parts thick, is one En. The colonnade is raised on a circular platform reached by seven steps, while the floor of the hall is raised one step above this level. The entrance to this hall is a doorway two entablatures seventy-nine parts in height by one entablature and twenty parts in width. Half of the plan shows the arrangement of the columns and shows that their capitals are placed square with the radii which pass through the columns. It will be necessary in drawing an elevation, to draw the plan of all the capitals since each one is seen in a different position, and it is only by means of the plan that the position of the details which make up the capital can be determined. Notice that the plinths of the bases, which, up to the present time have been square in plan, are here circular because their corners would partially block up the spaces between the columns. The other quarter of the plan shows the disposition of the ceiling of the portico, the soffit of the exterior cornice, and the caissons of the cupola.

171. The ceiling of the portico rests upon a small cornice and is divided into panels, which correspond to the columns and the spaces between the columns. In order to draw the caissons of the cupola, it will be necessary to repeat Plate R and go back to this study for the details of the lantern.

PLATE T.

172. In Plate XXXII is found a pavilion in the Mutular Doric Order. It is to be drawn with the border line of the same size as in the other plates, but, by omitting the plan here shown, it will be possible to increase the height of the building considerably and still bring it within the outlines of the drawing.

173. This small building is raised ten steps above the level of a garden, and is composed of a portico "in antis," giving access to the room beyond. The plan forms a square from center to center of the corner pilasters. This dimension corresponds to nine divisions, center to center, of the triglyphs in the entablature.

174. The four pilasters of the lateral facade form three regular bays of three spacings of the triglyphs. The intercolumniation in the center of the principal facade or portico is three entablatures, five times the distance from the center of one triglyph to the center of another, which is sixty parts, and the space between the antae and the columns is one entablature and twenty parts, or twice the distance between the triglyphs, center to center. The depth of the portico corresponds to one bay of the pilasters of the lateral facade, and the divisions of the pilasters of the rear facade correspond to the columns of the portico. In the middle of this rear facade is found a window which lights the interior; this window is twice its width in height and is placed above a wainscot of the height (1 En) shown in the section.

175. The entrance door is decorated with a frame similar to that in Plate XXV, and has an entablature with a pediment whose details are given on this plate at C. The entablature which surrounds the ceiling of the portico and of the hall is also the same as was used in Plate XXV.

176. The bases of wall and portico, and of the lateral and rear facades, are composed of a plain pedestal, or dado, one entablature in height, and with a rusticated part three entablatures high.

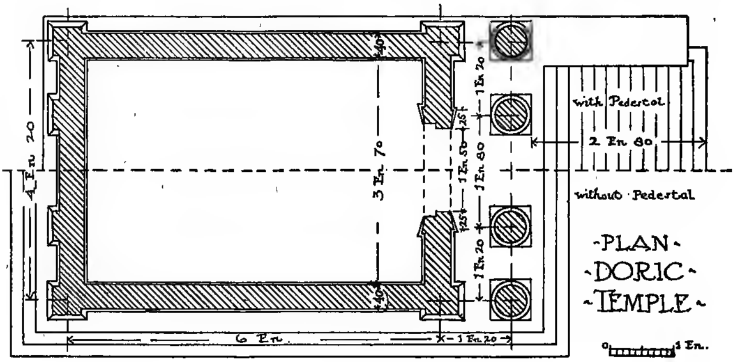

Fig. 30.

"Rusticated" applies to masonry work in which the joints are strongly emphasized. The dado has a plinth base of a height corresponding to the height of the column base, and a cap fourteen parts high. The bead and congé of the bases continue around and above this plinth; the rusticated stones are alternately twenty-six and sixty-eight parts wide with sinkages of two parts.

177. The roof is pyramidal in form and is crowned by a pineapple, of which the detail is given at D in this plate, XXXII, and the balustrade shown at the left-hand side of the facade would be the rail of a terrace on the edge of which this pavilion is located. This terrace, although the pavilion does not communicate with it, would be accessible by flights of steps placed laterally. For this the student may exercise his own imagination, and draw out separately at a smaller scale a plan giving his idea of the general arrangement.

PLATE U.

178. The facade of a Doric temple is to be drawn by the student from the plan shown in Fig. 30. The measurements necessary for the placing of the columns are here given, and further than this he is to supply their proper proportions and heights, as well as the necessary details, from the various drawings illustrating this order, which he has already studied. The four-columned portico on the front is crowned with a pediment, the proportions of which must be ascertained after the principle shown in Plates XXXII or XXXIII. This plate is to be drawn out with the border lines 20″×28″ in size.

179. The proportions and general scheme for laying out this problem will be found in the illustration of the Ionic Portico, Plate XXXIII. The various details both for the exterior entablature and for the entablature inside the temple, as well as the architraves for the entrance door, have already been given. The main facade or front elevation should be drawn to the center line which passes through the apex of the pediment and through the axis of the doorway. The section on this plate may be omitted, in which particular there will be a difference between this problem and the problem of the Ionic Order. In the plan it will be noticed that half has been shown with a pedestal, while the other half rests directly on a platform or "stylobate." It would be better to draw this order with a pedestal and to indicate by a dotted line the contour of the steps leading from the stylobate to the ground. The method of constructing the slope of the pediment has already been explained, and has also been shown on Plate XXXIII. This is essentially the same problem as that given under the Ionic Order, but the details and the proportions, it will be seen, are distinctly different.

PLATE V.

180. The Ionic Temple, with portico, shown in Plate XXXIII is to be drawn at the same size as the last plate, 20″×28″. These two drawings when finished should resemble each other, save that in the preceding exercise the full facade of the temple is shown, while in this plate of the Ionic Order a half facade and section are to be combined as illustrated.

181. The exterior face of the wall is formed with rusticated joints, that is to say, the joints of the stones form triangular recesses or grooves as shown at C, Plate XXIX. This decorative scheme is at the same time a logical construction because, the angles of the stones being obtuse, the edges are less liable to be broken off.

PLATE W.

182. This exercise is one of superposition and, as the same principle may be applied throughout the use of the other orders, it is believed that one drawing devoted to this subject will be amply sufficient. The student is required to reproduce the drawing shown in Fig. 23, at the size of 13″×18″ and to complete in his drawing all the details of the mouldings, windows, doorways, etc., where the same are only blocked in upon this figure. The considerations in regard to superposition, stated in the text in paragraphs 116 to 132, must be carefully observed.

PLATE X.

183. The subject of this study, Plate X, is the central part of the facade of an edifice; assume it is to be a library or public building of a similar character. The Corinthian Order is raised on a series of pedestals. The interior level of the edifice is raised above the exterior ground level and is reached by a staircase which will prove to be an interesting part of this study. This staircase is in two parts, each part composed of two flights with an intermediate landing. The first flight has twelve risers up to the landing; the second has eight risers up to the top of a wide landing which is placed before the entrance and on the axis of the edifice. A balustrade with two pedestals, on which might be placed statues or candelabras, surmounts the supporting wall of the landing. This supporting wall is finished on each side by a pillar on which is placed a vase, and is decorated with rusticated joints. The central part, corresponding to the balustrade, forms a projection; a niche decorated with a fountain and semi-circular basin would be practicable below this space. The entrance door of the edifice is in the form of an arch, covered with a pediment of the Ionic Order. The Corinthian columns forming the corners of the projection are coupled, that is to say, the space which separates them is less than the minimum of the regular intercolumniation.

184. The student is required to design, arrange and draw upon a plate, the size of 20″ × 28″, some such problem as is shown in Plate XXXIV, termed an Entrance or Monumental Approach. He may use any orders that he may choose for this problem, but should remember to maintain a proper relation between them in scale and size. He must not follow exactly this arrangement but must introduce such a variety in the plan as will give him a problem in elevation different from the one here solved.